

**Modern development studies as a  
resource for understanding  
working animal use in later human  
prehistory: the example of 4<sup>th</sup>-3<sup>rd</sup>  
millennium BC Mesopotamia**

**Volume I**

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***Volume I (Text)***

***Volume II (Appendices)***

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**I, Jill Rosamund Goulder, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.**

**Jill Goulder**

**Date            12 July 2018**

## Abstract

This thesis develops and employs a novel interdisciplinary tool for examining the practical implications of early systematic working-animal use in prehistoric contexts, on which only fragmentary evidence is otherwise available. I explore the potential of this tool – modern development studies – through an extended case study: the use of working animals in Mesopotamia, in the 4<sup>th</sup> and 3<sup>rd</sup> millennium BC. The aim throughout is to broaden substantially the range of archaeological and historical inference, rather than to propose new high-level models.

For achieving this aim, I use close qualitative analysis of the large body of published official and NGO studies of working-animal use today, particularly in regions where working cattle and donkeys are recent adoptions and mechanisation is minimal. These data, little-used as yet in archaeology, shed light on the day-to-day practicalities of working-animal adoption and management – breeding, supply, and maintenance. They further provide significant new bottom-up insights into common community-level social and economic levelling mechanisms such as hiring and lending of working animals, suggesting a revision to established models of social inequality relating to their adoption.

One major outcome of this analysis is the argument for greater recognition of the donkey – multi-function, low-maintenance – as a significant working force in late prehistoric Mesopotamia, challenging the established ox-focused models upon which many current reconstructions rely. The scarcity of donkey remains in food-middens has contributed to this neglect. Donkeys – and female cows – are widely employed in many modern developing regions for tilling light soils, and ploughing is often a minority element of working-animal use. Here the case is made for a similar range of roles in early Mesopotamia, for example in the myriad short-distance transportation tasks that form a central element of their use today, and in the rural ‘private sector’ now recognised as present outside the purview of elite, urban texts.

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**Modern development studies as a resource for  
understanding working animal use in later human prehistory:  
the example of 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamia**

## **Preface**

My thesis subject stems from an early interest in the phenomenon of human-animal relationships in antiquity as initially explored in Andrew Sherratt's Secondary Products Revolution model (1981; see Chapter II.1), developing into a particular investigation of the on-the-ground consequences of the adoption of working donkeys and cattle in Mesopotamia, in the day-to-day context of their systematic use rather than relating to zooarchaeological examination of evidence of earliest adoption or to the higher-level consideration of their larger-scale social and economic impact. My researches soon uncovered a large body of modern official and NGO development studies on this subject, in sub-Saharan Africa and other developing regions relying significantly upon working animals (Chapter I.2), which has been under-utilised as a source of potential analogy with cultures in antiquity also adjusting to the systematic use of working donkeys and cattle.

This modern material therefore forms the backbone of my thesis work, which is intended both to support new arguments about the impact of working donkeys and cattle in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC in Mesopotamia and to supply resources for further analysis and application by field archaeologists in particular.

Elements of this thesis have featured in two academic publications to date (as well as a number of conference papers):

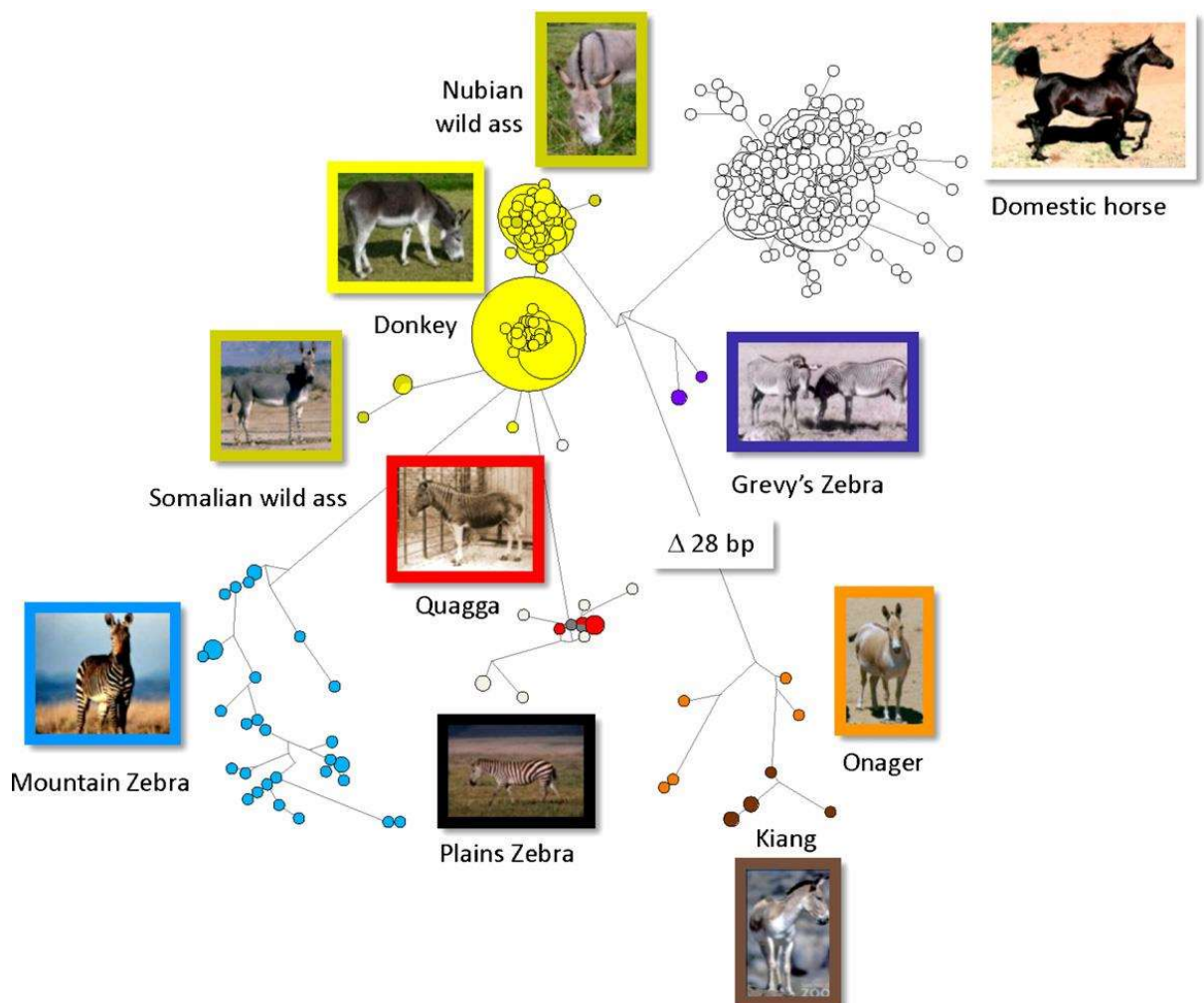
- Goulder, J. (2016). Fair exchange: utilisation of working animals (and women) in ancient Mesopotamia and modern Africa. *Anthropology of the Middle East* 11/1, 66-84
- Goulder, J. (in press). Invisible donkeys in ancient Mesopotamia: new insights from modern studies in sub-Saharan Africa, 12th ASWA proceedings, Groningen Archaeological Series

## Glossary

Table 1: Glossary

Reference	Explanation
Dates BC	Cal. BC unless stated
JG Burkina Faso 2013, JG Ethiopia 2014	These refer to material from two short research trips which I made to Africa, funded by the UCL Doctoral School, the UCL Institute of Archaeology and the British Institute in Eastern Africa. My primary aim was not to collect significant original material but to gain understanding of the environment relating to the many studies which form the data-set for my thesis. Any personal observations from these visits are referenced in the text as JG Burkina Faso 2013 and JG Ethiopia 2014.
Cattle	I refer to cattle generically, and also specifically to oxen (castrated males) and cows (this always indicates the female of the species). See Chapter III.1 for notes on taurine and zebu cattle
Donkeys (wild and domesticated) and onagers	<i>Equus</i> , briefly for the purpose of this work, today comprises horses ( <i>E. ferus caballus</i> and the related <i>E. ferus przewalski</i> ), donkeys ( <i>E. asinus</i> ), zebras (various types including the quagga) and hemiones ( <i>E. hemionus</i> , with various geographically-differentiated branches including the onager, kiang and kulan, some rare or extinct; see Figure 1). The different <i>Equus</i> species can interbreed but normally produce sterile offspring, as with the horse/ donkey mule. In studies on the Ancient Near East <i>E. hemionus</i> is commonly termed both ‘hemione’ and the more region-specific ‘onager’; I generally use the latter term. There are some uncertain hypotheses as to the existence of a small equid, <i>E. hydruntinus</i> , possibly related to the hemione or zebra, inhabiting the mid-Levant and Anatolia but extinct since the early Holocene (APP II.43). <i>E. asinus</i> is descended from Nubian and (probably to a lesser extent) Somali clades; truly wild versions are almost extinct (Geigl and Grange 2012:89). Some commentators elaborate the donkey species as the wild <i>E. africanus</i> and domesticated sub-species <i>E. africanus asinus</i> , but in view of the well-evidenced continued close blending of wild and working donkeys throughout history, I continue with the overall term <i>E. asinus</i> . Similarly, while certain commentators label non-domesticated versions as ‘ass’ or ‘wild ass’ and domesticated ones as ‘donkey’, I and others consider ‘ass’ and the more modern term ‘donkey’ as synonymous, and I use the latter term throughout.
Semi-wild (as in Chapters IV.2, VI.2 and VII.1)	I use this term for donkeys which live freely in the wild but which have become familiar over time with human groups living in the region, who may ‘collect’ them and use them <i>ad hoc</i> for transport.

	This term differs from 'feral', which applies to escaped domesticated animals and their offspring
Intensive and extensive farming	I discuss differing usage of these terms in Chapter V.6
Trade	I describe my use of this term (as opposed to e.g. 'exchange') in Chapter VII.3
Western/developed-world	These terms are unavoidably laden with political meaning; but for brevity in this document I have used them at times to indicate activities, initiatives and situations in or emanating from European, American and other generally wealthy regions, in contrast with developing regions formerly labelled 'Third World'



*Figure 1: 'Median joining network (Bandelt et al., 1999) depicting the relationships between extant equids based on 408 bp of the mitochondrial hypervariable region' (Geigl and Grange 2012:97, by permission)*



## **Mesopotamian chronology**

Table 2: Mesopotamian chronology

BC (cal.)	Period	Notes
(4400)4200-3900	Late Ubaid	In S. Levant, Mid/ Late Chalcolithic 4200-3200; in Egypt, Naqada I 4000-3500
3900-3600	Early Uruk	In Egypt, Naqada II 3800-3300
3600-3400	Mid Uruk	In S. Levant, EBIA (3700)3800-3300
3400-3200	Late Uruk	Eanna IVa pictographs; in Egypt, Naqada III 3300-3100
3200 (3000)-3100 (2900)	Jemdet Nasr	Archaic texts (and late Uruk); in S. Levant, EBI to (3100)2900
3100-2900	Early Dynastic I	In Egypt, Early Dynastic 3100-2650
2900-c.2600	Early Dynastic II	Mari I; Ebla; Ur; in S. Levant, EBII/III
c.2600-2350	Early Dynastic III	Ur burials; Abu Salabikh; Ebla; in S. Levant, EBII/III; in Egypt, Old Kingdom 2675-2130
2350-2150	Old Akkadian	Sargon; Beydar
2300(2112)-2000	Ur III	Akkad, Umma, Lagash/ Girsu, Nippur, Isin, Larsa, Adab, Drehem, Gudea
2000(1900)-1600(1800)	Old Assyrian	Kaneš; Hammurabi
(2000,1900) 1830-1759 (1600)	Old Babylonian	Mari II, Amorites
1700-1500	Early Assyrian	<i>Farmer's Instructions</i> ; Kassite
1450-1000	Middle Assyrian	

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# I INTRODUCTION AND APPROACHES

## I.1 Introduction

### ***Approaches to study of working animals in antiquity***

#### Working animals: a bottom-up approach

In his introduction to *Economy and Society in Prehistoric Europe* (1997a:3), Andrew Sherratt suggests that there have been, in archaeology and more broadly in European historical commentary, cycles of 'oscillation between system-building and deconstruction, between attempts to create general models and the desire to create interpretative metaphors', arguing that 'both approaches have elements which are useful and necessary, and that each acts to correct the excesses of the other.' He proposes that 'we attempt to rethink the nature of these larger processes using the insights which we have gained in contemplating the smaller ones'. This bottom-up approach can be pursued with particular relevance in Sherratt's own subject, the impact of working animals at the time of their early systematic use in the Near East and Europe.

#### Ox-focused high-level models

My thesis focuses on the example of late 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, but there is wider applicability of my approach and data-set to other Ancient Near Eastern and European cultures. In existing models and reconstructions of working-animal use in this important period, ploughing oxen have commonly held centre stage, following Sherratt's (1981) seminal proposition of a Secondary Products Revolution. Engels (1884), Goody (1976, 1971), Comaroff (1985), Boserup (1965, 1970, 1990) and others have evolved high-level models of wealth disparity, social status, labour use, community and kinship interaction emerging from adoption of ox-ploughing, notably in relation to the role and status of women. It has become evident through my new research, though, that such approaches risk bypassing key findings, not least in relation to the use of donkeys and (female) cows for work and to the essential role of short-distance transport.

#### A new approach: analogy with modern working-animal use

I have taken late 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia as a case-study not because this important period has good existing evidence of the day-to-day impact of working-animal use but because it has not. Zooarchaeological evidence is limited,

particularly on donkeys, and texts and depictions are inevitably confined to describing elite/ urban circumstances, with only incidental material on practical detail of working-animal impact and maintenance at community level. (See my description below of my approach to these data, and my sub-chapter on 'The Mesopotamian 'private sector'' in Chapter II.1.) In this thesis, in a drive to populate this important Mesopotamian period with working animals and the short-term local implications of their adoption, I employ a novel interdisciplinary approach to examination of the day-to-day role and impact of working animals on communities, through analogy with studies of modern developing-world cultures using donkeys and cattle for work in circumstances bearing some local relation to situations in antiquity. A key objective has been to challenge existing archaeological assumptions about the role and on-the-ground impact of these animals in early complex societies, offering foundations for corresponding implications for higher-level social and economic theory. The complex minutiae of daily life with working animals – using a ploughing ox year-round, keeping a multi-purpose working cow, developing new income sources and household labour systems from donkey ownership – build up to a series of models hardly proposed yet. This approach will in particular assist in reconstruction of social and economic systems in the small independent enterprises – farming and transportation – below the radar of urban, elite-commissioned texts but now becoming evident in the record of 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia (see Chapter II.1).

While such a heuristic approach may not lead to a formal new model, it can take us a large step further towards this than 'merely expanding the range of possibilities' (Halstead 2014:332). My goal is in essence to provide 'a guide to the questions we should be asking about the past' (Halstead 1987a:77) in the field of working-animal use for transport and traction, through not only providing the groundwork for further study – including a compendium of the modern sources in my Appendices listings – but reminding commentators on 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia (and other periods and times of adoption of working animals) of the implications of the advent of a new work resource that multiplies social and economic options at household level.

There has been only limited archaeological use of such modern sources in Ancient Near Eastern studies to date, and my thesis methodology is explicitly to emulate key post-Sherratt commentators on working animals by drawing new explanations and clarifications from modern analogy. Bogucki (1993), a key post-Sherratt source for

insight on the implications of the adoption of working animals in early Europe, cites the African work of Barrett *et al.* (1982; a large survey in 27 villages in NE Burkina Faso), Singh (1988; a large qualitative survey among farming families in 7 villages in central Burkina Faso), and McCann (1984) and Peters (1986; overviews by experts in Ethiopia and Botswana), to support arguments on the economics of working animal use in relation to labour. Brodie (2008), focusing on the Aegean, cites four similar African sources, and Goody (1976) refers to several of the same genre as examples of his wider findings; Halstead (e.g. 2014) makes use of many years of informal ethnographic observation among traditional farmers in present-day Greece. Mesopotamian archaeology is to date insufficiently geared to interpreting the ancient record in the light of indicators of working-animal use, and I argue the need for a new working-animal mindedness among fieldworkers and commentators, based on practical understanding of the likely traces of their presence and impact. My aim is for insights from my thesis to offer practical context, constraints and possibilities for the inclusion of working-animal presence in archaeological interpretation of cultures such as Uruk-period Mesopotamia.

#### Sources for modern working-animal use study

My data-set of modern studies, largely relating to developing regions, is described in detail in Chapter I.2 and listed in full in Appendix I.2. My aim is not comprehensiveness, but a well-based large, representative sample of key accounts of modern use of working animals, particularly those involving societies previously unfamiliar with any form of power except that of humans for agriculture and transport. These shed considerable light on enabling mechanisms for working-animal use such as breeding and supply, training, hiring and lending, grazing and foddering, often in situations where the facilities today include little that was not available in the 4<sup>th</sup> millennium BC. A further research resource has been the published material on the different physiological and behavioural characteristics of working cattle and donkeys (see below in Chapter I.2, and Chapter III.1); an imperfect recognition of their respective abilities and limitations can lead to an over-narrow view of their roles and value in the past and my objective has been to test and offer revisions to common assumptions about their relative capabilities.

Although for conciseness I have broadly used the term 'ethnographic studies', many of my regional sources are not strictly ethnographic (see Chapter I.2) but have rather been published as part of an increasing official and NGO-instigated drive to encourage and monitor the use of working donkeys and cattle in sub-Saharan Africa

in particular as a more sustainable alternative to mechanisation. The European colonial history of this latter region, and its strong candidacy for developed-country aid, has led to the publication of a unique large body of official and NGO studies on responses and adaptations to the new animal facility. A key criterion for inclusion of a study has been that it places working animals at the centre of its discourse and examines a culture where working animals form a direct and significant alternative to manual transport and labour, in a general absence of mechanical means beyond ard-style ploughs. I describe other criteria and constraints in Chapter I.2, and note in APP I.1 some language restrictions.

For the present study, direct analogy of the use of working animals in the modern Near East would be largely inappropriate, given the extent of mechanisation in the relevant countries (see Chapter I.2) and the minor role of working animals (and of working-animal studies) in much of that region today; Gould and Watson (1982:358) and Wylie (2002:152) concur in suggesting that convergence of a broad range of criteria is often more relevant.

### ***Ancient and modern: a new complementary approach***

As I underline in this introductory chapter, my thesis aim is to provide new insights to supplement the very limited data from antiquity on the day-to-day impact of use of working donkeys and cattle, as well as more broadly demonstrating the value of modern analogy. My approach is driven by the modern data: for my findings from my data-set on modern use of working animals, I have sought examples of parallel indications in the material from antiquity, searching among key commentators on Mesopotamia and sometimes elsewhere for relevant textual, representational, zooarchaeological or other archaeological examples, my thesis point being that these are at best fragmentary and will benefit from the addition of modern material to shed light on the realities of working-animal adoption in this period.

I discuss the modern and ancient material by working-animal theme in the chapters that form the body of this thesis, with the textual and other data therefore necessarily embedded throughout the themed chapters, to support particular individual modern findings. To give an example of this embedding, in Chapter IV.1 on donkey-breeding I cite Foster's (1977:36) and Zarins' (2014:199) accounts of 3<sup>rd</sup>-millennium BC commercial texts detailing trading of donkeys, including a reference

in a tablet from Tello to more than 700 donkeys transferred to Lagash – a Mesopotamian demand hub – from Gutium, a major donkey-supply region in the Zagros.

An important point to make is that I am not attempting an overall picture of working animals in Mesopotamia. Where I have found no modern material in the development studies for analogy with antiquity (e.g. patterns of movement of working animals, diachronic studies), or insufficient clues from antiquity to relate to modern findings (e.g. the use of working animals by women), I do not pursue the subject.

I have not approached the Mesopotamian texts directly to any extent, as this is not my area of expertise – and, as I underline throughout, their story is heavily biased and I aim to look afresh. I have noted instances among major commentators on texts that indicate areas where the modern material can shed new light, for example on the breeding of cattle and donkeys for work and the practical arrangement of plough-teams and foddering. Some of the most useful commentaries on textual references to working cattle and donkeys in 3<sup>rd</sup>-millennium BC Mesopotamia are provided by Adams 2008, Foster 1977, Heimpel 1994/ 1995, Liverani 2006, Maekawa 1979a/ 1979b/ 1984, Postgate 1986, Renger 1990, Sallaberger 1996/ 1998/ 2014, Steinkeller 1990/ 2004/ 2007, Tani 1996, Vila 2006, Wright 1996 and Zarins 2014, drawing on texts from Umma, Girsu, Lagash, Mari, Drehem, Ebla, Nippur and Beydar. I have also referred to textual references from several dozen other commentators, each referenced as appropriate in the chapters or in Appendix II (see below for a description of this key reference section). Discussion of iconography in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia is dominated by Littauer and Crouwel ([1973] 2002/ [1974] 2002/ 1979/ 1990, Littauer [1983] 2002), and in recent years Zarins 2014, but its elite nature limits its value for my ground-level focus. I also cite Bakker *et al.* 1999 and Civil 1994 on vehicle iconography, and a number of commentators refer to well-known examples such as the Uruk-period pictographs (APP II.18).

The zooarchaeological references in my thesis differ from textual ones in that they rarely relate to subjects for modern analogy, but rather form explanatory background as to the sparseness of archaeological material on working animals – in particular donkeys – in Mesopotamia of this period. I refer to interpretations of the donkey remains at Tell Rubeidheh (Payne 1988), Abu Salabikh (Clutton-Brock

1986), Tell es-Sweyhat (Weber 1997) and Tell Brak (Clutton-Brock 1989/ 2001/ 2003, Clutton-Brock and Davies 1993), and report briefly in Chapter II.2 on the phenomenon of donkey burials in elite circumstances (Milevski 2011, Way 2010/ 2011 and others (APP II.21)). Most other zooarchaeological references used relate to detection of the domestication and presence of working animals, including work-related traumas, use for meat, and DNA (APP II.21, II.44): notably Bartosiewicz 2006, Bartosiewicz *et al.* 1997, Clutton-Brock 1986/ 1992/ 2001/ 2012, Clutton-Brock and Davies 1993, Grigson 1995/ 2003, Halstead and Isaakidou 2011, Isaakidou 2006, Shackelford *et al.* 2013, Vila 1998/ 2006, Wapnish 1997 and Zeder 1986/ 1994.

I provide in Chapter IX.1 a brief concluding overview of the potential contribution of these textual, iconographic, zooarchaeological and other tools for detection of the role and management of working cattle and donkeys. In particular, Zarins' comprehensive 2014 work *The domestication of Equidae in third-millennium BCE Mesopotamia* describes and debates much of the zooarchaeological, textual and representational evidence to date of working donkeys in the 3<sup>rd</sup> millennium BC (and earlier) in Mesopotamia and also in the southern Levant and Egypt. In re-examining many of the classic equid finds he has recorded significant examples of severely inaccurate identifications and faulty contextual information (Zarins 2014:53-65, referred to in Chapter II.2). Zarins concludes (2014:82) '[i]n sum, it appears the evidence for *E. asinus* in its domestic state throughout Egypt and Southwest Asia is *uniformly rare everywhere* [author's italics].'

In view of the sparse material from 4<sup>th</sup>- 3<sup>rd</sup>-millennium BC Mesopotamia (which as noted above has been the motivation for my search for alternative approaches), I have also collated clues from key commentary on similar periods in the southern Levant and Egypt, always focusing on the practicalities of working-animal use and husbandry. The southern Levant material largely relates to the use of donkeys for transportation from the 4<sup>th</sup> millennium BC on, with insights into the associated social and economic changes. Key commentators are listed in APP II.36 (the Egypt-Canaan long-distance route) and APP II.22 (the intensive ore and worked-copper movement from Faynan to the Beersheva valley and beyond). Levant studies also encompass commentary on the phenomenon of donkey burials in elite circumstances and the related presence of donkey figurines (Chapter II.2 and APP II.21), and the debated system of deducing the advent of deep ploughing with oxen



through calculation from faunal remains of the percentage of cattle in the total animal record (Chapter IV.2).

Egypt offers some direct archaeological evidence of the use of working donkeys, notably through the excavation by Förster of the chain of staging-posts forming the Abu Ballas caravan-trail, dating back to the 3<sup>rd</sup> millennium BC (Chapter VII.3, APP II.22). 3<sup>rd</sup>-millennium BC Egyptian texts recount the large-scale owning of donkeys for caravan work (APP II.21); in the 2<sup>nd</sup>-millennium BC the Deir el-Medina texts give useful comparability with modern studies of the individual-scale hiring and purchasing of donkeys (Janssen 2005, Janssen *et al.* 2003, McDowell 1999). Depictions of domesticated donkeys appear from the late 4<sup>th</sup> millennium BC and are common in tomb-paintings (e.g. Brewer *et al.* 1994, Osborn and Osbornová 1998, Power 2004); zooarchaeological evidence includes famously the pair of donkeys with work pathologies buried at Abydos in 3000 BC (Chapter IV.1). Separately, the widespread use of (female) cows for ploughing in Egypt, from antiquity to today, is discussed in Chapter III.2.

I also pull in at times references to texts from early 2<sup>nd</sup> millennium BC Mesopotamia, which have material on the day-to-day practicalities of use of working cattle and donkeys which can potentially (with caveats as to political and economic differences) illuminate earlier on-the-ground situations. In all cases I am not studying these additional regions or periods per se, but using commentary on them as resources for contributing to understanding of working-animal matters in my core region and period. The early 2<sup>nd</sup> millennium BC body of texts includes some key epigraphic accounts with useful parallels with modern practices: *The Debate Between the Hoe and the Plough* (Black *et al.* 1998-2006a), *The Code of Hammurabi* (see APP II.32), the *Laws about Rented Oxen* (Roth 1980), and later the *Farmer's Instructions* (Black *et al.* 1998-2006d). I also cite Stol's 1995 *Old Babylonian cattle* in a number of instances, as although outside my period of focus it provides a useful concentrated body of text-based material on practical cattle husbandry in antiquity. I discuss only briefly the famous body of early 2<sup>nd</sup>-millennium BC texts from Kültepe on the Aššur-Kaneš caravans (see APP II.15 for commentators), as I lack significant modern analogical material for comparison.

### ***Research aims***

Since Gordon Childe's defining in the 1930s of the Urban Revolution in Mesopotamia, the analysis of 4<sup>th</sup>-3<sup>rd</sup> millennium BC economy and society in this region has been dominated by large-scale themes. From the 1980s, discussions of the 'Uruk expansion' (see Chapter II.1) by Guillermo Algaze and others have taken this region and period as a platform for the introduction of world systems theory into the archaeology of the Middle East. The emphasis has remained on macro-scale patterns, with a particular focus on long-distance trade patterns, and on the advent of ploughing and the implications for urbanisation.

Modern studies of working-animal use have a contributory rather than driving role for these established debates, which are firmly rooted in the historical and geographical conditions of later prehistory. It is equally valid, though, to approach changes in human-animal relations at the micro scale, from the bottom up, including both basic logistical matters of breeding, supply, training, grazing and foddering, and the impact of working animals on local economies through processes such as labour adjustments, hiring and lending. My primary aim in this thesis has been to develop an original resource for describing and analysing these small-scale features of modern animal use, in a way that might lend itself to archaeological comparisons and to consideration of the day-to-day implications, not always immediately visible archaeologically.

The potential of this resource is tested throughout this thesis by cross-referencing the limited relevant archaeological, epigraphic and pictorial sources as they bear on particular issues. I do not propose a new model: insofar as this process addresses existing debates on 'world systems', 'urbanisation' and 'long-distance trade', its primary purpose is to highlight the many aspects of human-animal relations that are neglected or under-studied in such large-scale models. Further research based on these insights will offer opportunities to reassess such macro models in the light of new appreciation of the relevant practicalities of working-animal use.

My research aims are therefore:

- I. **To demonstrate a new interdisciplinary approach to fleshing out the currently thin and fragmentary evidence for day-to-day use of working animals in 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamia, drawing on modern**

**published studies of working-animal use in developing regions – particularly those previously unfamiliar with working animals and with little mechanisation of cultivation or transport.**

My overall aim has been to examine modern working-animal accounts through ethology (the study of innate animal behaviour: Chapter 1.2) and animal physiology, placing the daily practicalities of the animals at the centre, with implications for the value of this new tool in other periods and regions of early working-animal use. I argue for modern analogical material, suitably used, forming a valuable guide and incentive to archaeological researchers through greater consciousness of the ubiquitous but often invisible presence of working animals, as well as providing groundwork for revision of high-level models. Specifically my objectives are:

- **To provide insights from modern development studies into the often unrecognised scale of new industries, jobs and ancillary tasks consequent on the systematic adoption of working donkeys and cattle for work.**

Archaeological evidence for this sector is thin: the new activities (breeding and supply systems, grazing and fodder provision) are often outside the scope of elite texts and generate limited material culture, though new analysis techniques are offering improved detection potential.

- **A practical briefing for field archaeologists and commentators studying periods of early systematic working-animal adoption, working through the example of Mesopotamia.**

I provide a detailed comparison of the physiology and behaviour of working donkeys, oxen and cows, written specifically for archaeologists and highlighting the resultant wholly different husbandry needs and usage patterns, with implications for wider archaeological interpretation.

- II. **To challenge the focus on ox-ploughing persisting in models of use of working animals in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, addressing in particular the ‘invisible donkey’.**

I discuss the long shadow of Sherratt’s secondary-products model and of a more generally Westerncentric bias towards assuming ox-ploughing, under which many anthropological commentators shelter without questioning the archaeological and practical bases. Working-animal usage patterns throughout

history underline the widespread additional use of female cows and donkeys for ploughing, with the advantages of heavy ploughing sometimes overstated.

Ploughing often forms a comparatively minor part of the annual round of animal work, with donkeys in particular extensively used for short-distance transport.

My objectives here are:

- **To highlight the underestimation of the donkey as a practical and economic force since its domestication, as demonstrated by robust evidence worldwide historically and in developing regions today.**

Donkeys have long been regarded as lowly animals, and modern development studies underline their very widespread use in rural households; this has potential parallels in the Mesopotamian 'private sector', largely ignored by the urban, elite-focused texts which have influenced Sherratt's and other models. Working donkeys also suffer from zooarchaeological invisibility: there are indications that in Mesopotamia as in many cultures up to the present they were not commonly eaten so do not feature significantly in settlement food middens.

- **To argue for new perspectives on anthropological models of social and economic inequality relating to the adoption of working animals, based on evidence from modern development studies**

Models of working-animal adoption often assume social/ economic inequality as a consequence or (in more recent arguments) precondition of working-animal adoption. While these may inevitably be present, modern study evidence makes a strong case for the widespread emergence of practical social and economic levelling mechanisms in modern developing-region cultures adopting working animals, such as systems for hiring and lending and for year-round utilisation. In particular the availability of donkeys for short-distance transport can provide significant economic and social improvement for disenfranchised groups such as women.

- III. **To append a fully-categorised compendium of my data-set, tabulated in detail by subject area, enabling further analogical use by researchers on the early systematic use of working animals.**

This large body of modern material, consisting in the main of NGO and officially-published studies covering working-animal use in developing regions today (see Chapter I.2 and Appendices I and II), offers a significant resource for field and

other archaeologists and a wider academic audience, in my example region and more widely.

## ***Exclusions***

The focus in my thesis is on subjects with some basis for the potential of broad comparison between my data-set of modern study analogical material and the possible scenario in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia. There are many interesting digressions available on for example larger-scale and diachronic evidence in antiquity such as patterns of movement and settlement data, but as I note above my data-set does not provide material for commentary.

### Animal exclusions

On the matter of domestication and the earliest use of cattle and donkeys for work I provide a scene-setting Chapter, II.2 History of domestication of working animals in the Ancient Near East, and some ancillary notes on techniques of domestication detection in Chapter IX.1, but otherwise as modern analogy is not available I do not focus on this subject.

Donkeys for pack and ploughing are fully reported on, but oxen only as ploughing animals: their use for pack is and very probably was limited outside certain cultures (APP II.23), so this subject is not covered. The well-known Levantine Chalcolithic ram and bovid figurines bearing items on their back (APP II.23), although hinting at early ad hoc experiments, were likely to have been allegorical; I have not explored use of sheep or goats for work in this thesis. There is much speculation about dates of possible domestication of dromedary and Bactrian camels in parts of Iran, perhaps initially for meat and milk, but alleged 3<sup>rd</sup>-millennium BC depictions in Mesopotamia and the Levant are likely to have been drawn from hearsay (APP II.23); they are excluded from my work.

Onager-donkey hybrids were certainly employed for work in the 3<sup>rd</sup> millennium BC, but they have no significant modern equivalents; the physiology and behaviour of mules – the horse-donkey hybrids now commonly used – are typically very different, so discussion of hybrids is confined to a note in Chapter II.2. Horses were effectively absent from Mesopotamia in most of the period under discussion, and

their use in much of sub-Saharan Africa is not widespread, so again I have included only a brief note in the same chapter; for similar reasons riding is excluded.

#### Exclusion of wheeled vehicles and other equipment

I am excluding detailed discussion of wheeled vehicles, sledges and travois, stationary power (e.g. pulling water from wells, milling, hoisting) and harness, as ancient/ modern comparison would involve interesting but lengthy analysis of vehicle and harnessing technologies then and now, complicated by the necessity of allowing for modern mechanical alternatives; for similar reasons I am not covering competing or complementary transport systems such as boats. However, in Chapter VII.2 for completeness I give a brief history of what is known about the advent and use of carts in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, with notes on their modern use; I have also briefly covered the early history of threshing-sledges and commented on the use in modern and recent developing cultures of sledges and travois. The subject of stationary power is briefly touched on in the same chapter, and the role of harness is discussed in Chapter IV.2.

#### ***Thesis content***

The present introductory chapter provides the backdrop for my main arguments and interdisciplinary approach to the little-addressed issue of the day-to-day practicalities of working-animal use in antiquity. This is followed by a description (Chapter I.2) of the modern studies that I have used and their origin and import, with a note on the history of working animals in sub-Saharan Africa and a brief discussion of the validity of ethnographic studies for archaeological interpretation. Part II gives an overview of the initial advent of working animals in the Ancient Near East, including a brief discussion of the influence and constraints of Sherratt's Secondary Products model with notes on the larger-scale political background of the period, including growing recognition of evidence of continuing non-centralised activities.

In Part III I give a brief explanation of the physiological and behavioural characteristics of donkeys and cattle which drive the very different social and agricultural trajectories of their adoption and systematic use. I also discuss the insufficiently-mentioned wide usage today of (female) cows for ploughing, and the implications for antiquity. Similarly, Part IV comprises an account of the often-

unmentioned practical facets of working animal adoption, from breeding and supply to husbandry and training. Part V focuses on the important but often misinterpreted history and practicalities of ploughing, from 4<sup>th</sup>-millennium BC Mesopotamia to the present day.

Part VI covers the important working-animal subjects of grazing/ foddering/ feeding and of hiring, lending and sharing for economic equilibrium. In Part VII I discuss in detail the vital role of the donkey for short-distance and long-distance transport, with a note on the use of other species for traction and transport.

In Part VIII I approach the anthropological world of Goody, Engels, Boserup *et al.* in addressing briefly the social implications of working-animal adoption, though focusing on the minutiae of daily life with working animals (from modern studies) in order to support and sometimes challenge the high-level models proposed.

Finally, in Chapter IX.1 I discuss the problems and opportunities of detecting the practical implications of working-animal usage in the early years in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, using the widening range of tools at our disposal. I then tentatively suggest areas for further research, particularly involving a new consciousness at site level of the possible recognition of animal-industry facilities such as corrals and foddering arrangements.

#### The role of Appendix II (the 'APP II' references in the text)

This thesis is strongly based on detailed published material from almost 1,000 ethnographic, archaeological and other sources, all listed in the bibliography. In order to manage the issue of citing multiple sources for each of the many individual items of information in the text, I have evolved an extensive series of tables with the citations listed by item within themes, giving author, date and page numbers. These tables are assembled in Appendix II in a separate volume, and are numbered and referred to in the main text as APP II.1, APP II.2 etc. Readers wishing to check the type/ number of references for any point (as commonly contained in brackets/ footnotes) can refer to Appendix II for a fully categorised list. This system not only clears the text of long lists of references, but provides a concentrated bibliography of sources for researchers wishing to look more deeply into a particular subject. This furthers my broader aim of offering my thesis to researchers as a compendium of material for study of the subject of working cattle and donkeys in modern developing countries and in the Ancient Near East.

## I.2 Modern studies of working animals

### ***A new body of studies: working animals in sub-Saharan Africa and worldwide***

#### Donkey use worldwide

More working donkeys are being used now than at any time in history (Hart 2012); the worldwide numbers are difficult to ascertain but are estimated at c.43-44 million (Burden and Thiemann 2015:376, Valette 2014:18), the two largest populations being in China and Ethiopia; the population in the former is now falling due to significant new Chinese demand for donkey-hides (see Chapter III.2). The worldwide working-animal population more generally is equally hard to calculate, but in recent years may be 200-250 million (Starkey 2011:11-12 – a major recent source of information on incidence by region). While much agricultural and transportation power in developing regions is still provided by humans, and some by mechanised equipment, working animals are widely used in Africa and in much of Asia and Latin America, and still on a smaller scale in parts of Europe (Panin and Ellis-Jones 1994:95, Pearson and Smith 1994:122, Starkey 1994a:66-9, Starkey 2011).

The donkey population in some sub-Saharan African regions is increasing, with donkey adoption spreading from village to village through neighbour recommendation (APP II.13 lists references to accounts in West Africa by Starkey and others). Peta Jones reports from South Africa that

Government officials from neighbouring countries such as Mozambique, Zambia and Malawi, usually with NGOs involved, are on the search for large numbers of donkeys to improve their agriculture, thinking even of having them flown into the areas where they are needed. (Jones [P.A.] 2009:2)

NGOs have been providing donkeys to refugees and migrants in Africa, to give them transport and income potential (Catley and Blakeway 2004:87). Use is declining overall in most other regions worldwide (Starkey 2011:11-12/30), and the working-animal profile is changing, for example in Asia and Latin America where donkey usage is holding up better than that of cattle and llamas respectively (Starkey 2011:12-14). In eastern Europe, cows and equids still have a significant working role; in the Near East, though, there is major mechanisation, with low usage now of donkeys in Turkey, Jordan and Lebanon, though donkeys are still a transportation staple in Iraq and Yemen (Starkey 2011:14/42/48-9). Competition to



donkey power includes tractors, bicycles (Ngendello and Heemskerk 2004:122, Yousef and Dill 1969:682) and motorcycles (Daborn 2011:¶2, Starkey 1998a:9).

There are still examples worldwide of lack of attention to the donkey in particular by some (urban) official bodies in Africa and elsewhere, who have often regarded donkeys as old-fashioned technology not in keeping with their modernising approach; APP II.34 lists references to this by regional experts and NGOs in Africa (Ethiopia, Kenya, Namibia, North Africa, South Africa), India and Mexico. Donkeys may be excluded from working-animal surveys and veterinary college curricula (APP II.34), for example in Mexico, and working-animal power generally in some regions 'is viewed as outdated, so when [its] case for support is argued the shutters come down and minds move to more populist themes as credit groups, women's income generation and rust resistant rice!' (Daborn 2011:¶1).

This invisibility of the donkey is more recently being rectified through studies generated by specialist NGOs and official bodies, notably on its advantages for use by women and other disenfranchised groups; see APP II.5 and Chapter VII.1 for references to the widespread acknowledgement in Africa and elsewhere of the role of donkeys in reducing the work burdens of women. In recent decades as enthusiasm for fossil-fuel technology wanes, there has more generally been a new focus by development agencies and NGOs on the value of promoting use of working animals in developing countries, particularly in sub-Saharan Africa where there has been no widespread history of use of donkeys and cattle for work (see below on the history of working animal use in sub-Saharan Africa). This has resulted in a series of major recent research initiatives, international colloquia and expert consultations, often led by individuals from the developing countries concerned. As I describe in detail in this thesis, the many published studies (listed in Appendix I.2, with content summaries) highlight the complexity of farm and household systems – and at the next level urban systems – which utilise working animals, and the central importance of their multifunctional role, of which ploughing is only a part.

#### Working-animal development studies worldwide

Modern NGO and official studies on working animals in the Middle East are scarce, for a range of reasons related to cultural attitudes to animals and inevitably to the history of damaging conflicts in this region; an exception is Tabbaa's (2003) account of the use and management of donkeys and mules in history and in the present day in Syria. In Asia some studies on the use of working animals are appearing, though

as the technology is long-established in the region there are fewer potential parallels than in sub-Saharan Africa with ancient early use. In modern Latin and Central America there is only limited published material on the role and activities of working animals, as the aid structure is very different and veterinarians take little interest in the offer of study initiatives as owners of these animals cannot afford veterinary services (de Aluja and Lopez 1991:2). My thesis therefore concentrates to a considerable extent on the material from sub-Saharan Africa (Figure 2), which as noted above has the twin advantages of rich new study data and an often comparatively pristine environment in which to study the first transitions from hoe agriculture to animal traction and from human portage to pack animal with no intermediate use of mechanical means (see below).



*Figure 2: Map showing sub-Saharan countries (© Jill Goulder 2017)*

A fruitful source of information on the impact of working-animal use in sub-Saharan Africa has been the website-based Animal Traction Network for Eastern and Southern Africa (ATNESA, [www.atnesa.org](http://www.atnesa.org); Figure 3), which has also circulated material from the West Africa Animal Traction Network, ENAP (Ethiopia), KENDAT (Kenya), RITAMAZ (Mozambique), SANAT (South Africa), TADAP (Tanzania), UNATCA (Uganda), SAMeP (Zambia), APNEZ (Zimbabwe), and other organisations including in South America and Asia. ATNESA has published the papers from a number of its international workshops on working-animal use held in various African countries, where specialists present overviews of the working-animal situation in their region or country (valued for their longer-term views), or the results of small-scale surveys in particular districts, providing some local statistics but mainly valued for their qualitative findings on themes, reasoning and motivations among those adopting and using working animals. It is hard to give typical examples; here are two indicative papers, given at international ATNESA workshops and then published in edited volumes of the proceedings and on the ATNESA website:

- *Gender issues in animal traction and rural transport in Uganda* (Lubwama 2000): the author, a specialist at the Agricultural Engineering and Appropriate Technology Research Institute in Uganda, outlines the historical background to the use of animal traction in Uganda and more recent developments, and discusses the issues of empowering women farmers through animal traction
- *Constraints to the extension of draft animal technology in the farming systems of Sierra Leone* (Bangura 1990): the author, a member of the Sierra Leone Work Oxen Project, reports on the results of a qualitative survey among the 13 ethnic groups in Sierra Leone on their acceptance of work oxen in their farming systems and the potential factors in variations

International colloquia are also held by major working-animal NGOs such as The Brooke, and the papers published, while international official organisations (FAO, ODI, World Bank) publish working papers. Academic institutions such as the Centre for Tropical Veterinary Medicine at the University of Edinburgh have published papers, edited volumes and academic journal articles; useful journal resources include Draught Animal News, Ethnozootecnie, Tropical Animal Health and Production, World Animal Review, Journal of Animal Sciences, and anthropological and agricultural titles. Mention should be made here of significant individual expert contributors to studies and overviews of working animals in sub-Saharan Africa and elsewhere, such as Professor Paul Starkey (see bibliography) and Drs Anne

Pearson and Denis Fielding from the Centre for Tropical Veterinary Medicine in Edinburgh.

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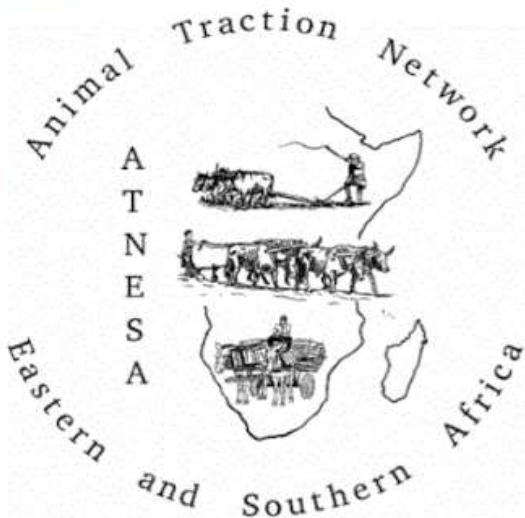
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Figure 3: ATNESA website ([www.atnesa.org](http://www.atnesa.org) [accessed 25 April 2018])

There are commonly significant limitations in developing countries on statistical information relating to working animals (particularly donkeys and (female) cows). Data provided by national governments to bodies such as the FAO suffer from difficulties of definition of working cattle and a widespread lack of attention to the population of donkeys; these data tend to be subject-specific and not easily subject to cross-analysis by user category or by their cultural context. This has prompted a

wide range of official and NGO funding for reports, studies and overviews of the use of working animals; with their qualitative and ground-based approach, these provide essential bases for official and NGO decision-making on funding and appropriate action at region and district level.

Larger-scale quantifiable development surveys are comparatively rare, for reasons of funding and of feasibility in rural areas; as with all the types of study and commentary mentioned here, the agenda of the survey – the reason for investing in it, and for the respondents participating – must be borne in mind. Typically the larger surveys cover a particular region of a country and include conversations with farmers and other working-animal users along with their families, plus observation over time. Questionnaires and animal-counting systems are sometimes employed, but in view of the practical difficulties of sampling the surveys tend to focus on attitudes and functional explanations. Such surveys may be funded by large working-animal NGOs such as The Brooke (e.g. Admassu and Shiferaw 2011), or through collaborations between academic institutions, international aid/development organisations and local development organisations or ministries, as with Barrett *et al.* (1982, backed by USAID and Michigan State University).

Finally, looking into history, there are 19<sup>th</sup>- and 20<sup>th</sup>-century AD works by explorers and anthropologists which include on-the-ground descriptions of working-animal use by traditional farmers, nomadic groups and pack-caravaneers.

#### A detailed qualitative approach

The 380 modern regional studies used for this document – many but not all relating to sub-Saharan Africa – are listed and categorised in Appendix I. Appendix I.1 summarises in tabular/ graph form the geographical location and date of the modern studies and commentaries used, while Appendix I.2 provides a brief note on the content of each. In view of the scarcity of relevant material for statistical analysis, and the widely-varying scale, purpose and methodology of the modern studies available, I have taken a qualitative analysis approach. Each study in its way sheds light on the daily actualities of using working animals, and on the farm-, household- and village-level impacts over time of their adoption. Through very detailed reading of these studies, I have extracted a large harvest of themes and categories of findings, and derived an assessment of the overall importance of each. This assessment takes into account the number of studies raising a given subject, the force of argument of each (strength of survey findings, expertise of commentators),

and any bias relating to the agenda of the study commissioners. Further weight is given to whether the factor is fundamental to action or has more of a leverage effect in aiding choice.

#### Caveats I: recognising biases of studies

As noted in the paragraphs below on the perils of ethnographic analogy, the findings of modern studies should not of course be accepted unconditionally. Farnham (1997:29-34) points out that African animal traction studies may range from anthropological modelling to accounts by agricultural engineers and agronomists, the latter sometimes based on trials at research stations rather than in the field; their agenda, often devised by urban-based official agents with little on-the-ground knowledge, is the promulgation of possibly isolated positive results (the view of Kjaerby 1983:14) in a drive to encourage local farmers to adopt new 'modern' agricultural systems. McCann (1995:15) concludes in Ethiopia that '[w]ith few exceptions, the dominant idiom for describing agriculture in the post-1945 years has been one in which scientific method rather than personal narrative has dominated.' Meanwhile, NGO-commissioned studies of the use of working animals in developing regions specifically address social and economic aspects, but are likely to pitch their sampling and reporting in line with their worthy aim of improving conditions for animals and encouraging donations, with the potential result of polarising findings into pre-intervention (bad) and post-intervention (good). With suitable filters, both categories of study can provide valuable material for the examination of situations in antiquity: as Albarella (2011:2) points out, '[e]thnoarchaeological research on human-animal relationships naturally covers economic and ecological, as well as social aspects'.

#### Caveats II: looking under official activity

In archaeological literature, explanations of major social change have traditionally been based on assumptions of elite control; but more recently there has been a move to focus on the cumulative effects of 'decision-making at the household level' (Jones [J.E.] 2010:16, referring to social change in the southern Levant Bronze Age), which may be a more suitable instrument for examination of the process of adoption and day-to-day usage of working animals. I have become conscious, during my analysis of the modern studies, of the factor of well-meaning authorities attempting to induct sub-Saharan African cultures into market-economy modes (cash crops etc), and have highlighted in this thesis examples of the subversive subsequent activities of the individuals – refusing to adopt or lapsing (see Chapter

V.4), changing animals to those more suited to their own needs, for example from oxen to donkeys.

On the matter of State control, it would of course be invidious to compare directly the various colonial, national government and NGO interventions in African development to authority influence on developments in the Ancient Near East, but it may be possible to learn about the reactions of groups to control or absence of control. Panin (1988) describes the manipulation of technological access by successive authorities in West Africa, where traction animals were supplied and supported, then withdrawn, then supplied but not supported. In several central African regions animal traction has been supported until recently by the state, but these authorities are now distancing themselves from agriculture, resulting in problems of funding and supply (Vall *et al.* 2002a:129). Meanwhile there is a wealth of examples in Africa, as everywhere, of strategies to avoid the penalties of central control, and this impinges upon use of working animals: in Ivory Coast, for example, farmers avoid keeping animals in villages because they encounter undue bureaucracy (Landais and Lhoste 1990:228).

### Caveats III: ecological issues

Soil and climate are of course among the many factors affecting choice and usage of working animals, and I refer to these where relevant as an analogical constraint. However, my data-set of modern studies would not be appropriate for systematic critical evaluation of these factors. Most of the studies are very small-scale, pinpricks in the often micro-varied ecological landscape, and in the cases of sub-Saharan Africa, the animals discussed have often initially been introduced to the area artificially. It must be borne in mind too that these development studies are not necessarily aimed at asking or answering relevant questions for my thesis purposes; they have different agendas, and the information gained for useful analogy is incidental to their aims. They are individually commissioned and carried out, and are by no means sufficiently uniform for comparison between studies.

My intention has therefore been to focus ethologically (see below) on irreducibles relating to the actuality of the animals and their daily management – something largely missing in model-driven commentary – and on arguing for recognition of the often complex nature of the decision paths that individuals and cultural groups take in relation to working-animal usage. Thus in a number of the modern studies both

donkeys and cattle are used for ploughing in the same local soil/ climate environment, for a range of individual cultural and other reasons (e.g. Chapter IV.1). While both Mesopotamia and sub-Saharan Africa have a range of soil types and so of strategies for ploughing, I refer in particular at times to use of ploughing animals in light, sandy soil (APP II.31). This is driven by my argument (Chapter II.1) that many archaeologists to date have accepted the ox-ploughing model without recognising that it derives from a construct assuming heavy soils; where lighter soils obtain, in parts of Mesopotamia as elsewhere, they are very suitable for ploughing by donkeys and female cows.

#### Working-animal capabilities

As outlined in Chapter I.1 above, I have also made use of a number of studies of donkey and cattle (and human porter) physiology and behaviour with the aim of establishing basic capabilities and propensities, applicable in the past as now, which can be assumed as influencing the mode of use of these different species. Donkeys were native to arid north-eastern Africa (see Chapter II.2); as noted in Chapter II.1, working donkeys found in Africa and Asia today have not generally been subject historically to strong selective breeding, and in physical capabilities and behaviour they generally resemble those domesticated in early periods. There is more of a separation between Africa's largely zebu-cross cattle and the taurines of 4<sup>th</sup>-millennium BC Mesopotamia, but as noted in Chapter III.1 there is evidence of convergence of adaptation among both species.

A large body of published practical experimentation and specialist commentary exists on the biological capabilities and constraints of donkeys in particular in relation to pack and traction, including work rates and capabilities, and food/ water needs and preferences. Dijkman (1992:153-5), Hagmann and Prasad (1995:231/235-7), Pearson and Vall (1998:309-12/315) and Renger (1990:269-72) report for example on physiological experiments on working-energy efficiency of donkeys and oxen, while Yousef *et al.* (1972) analyse the anatomical and mechanical factors in the low energy expenditure of working donkeys. Brodie (2008:303) argues in the context of the Aegean Bronze Age that donkeys are physiologically and behaviourally more suited than oxen to traction and transport use by small farming households in regions of light soil. Also of value are studies of the social behaviour of donkeys in the wild, relating to their propensity for taming and handling, pack-train and traction activity, and breeding in captivity (e.g. French 1997).



## ***Recent history of working animals in sub-Saharan Africa***

### Limited use of working animals until recent years

As noted above, a prime zone for relevant investigation of responses to the advent of working animals is sub-Saharan Africa, where in many regions the use of working cattle and donkeys was only introduced within the last 100 or even 50 years (APP II.41). Cattle (initially taurine; Chapter III.1) were domesticated for meat, milk and prestige by pastoralists in antiquity (Clutton-Brock 2012:50/109-10); there are some accounts of early modern use of oxen for pack (APP II.23, and a note in Chapter VII.1), and Kruit (1994:475) reports for example on long-established use of oxen and camels for lifting water in Niger. Donkeys are attested in small numbers in Kenyan pastoral herding contexts from the 1<sup>st</sup> millennium BC (Mitchell 2017:21; and continuing today), filtering down from the north or brought in by sea, and were later brought into sub-Saharan Africa by merchants in pack-caravans, as mentioned in an account of Ghana by the 11<sup>th</sup>-century AD geographer Al Bakri (Goody 1971:68). Joubert (1995:126/135) records the introduction of cattle and donkey traction and donkey pack into South Africa by European settlers in the 17<sup>th</sup> century AD, and Comaroff (1985:145), Starkey (2011:37) and Wood and Milimo (1994:344) in the 19<sup>th</sup> century AD, but in most sub-Saharan regions cattle and donkey use for work remained rare. Wheeled transportation was scarce in pre-colonial Africa (Goody 1971:6), and horses were largely used for riding by elites.

### Factors in non-adoption

During the 20<sup>th</sup> century AD awareness among farmers of animal-traction possibilities must inevitably have increased, but adoption largely waited for specific colonial or other external initiatives. A range of commentators suggest that factors in the widespread non-adoption of animals for traction may have included the lack of suitable animals, endemic animal disease in some regions, cultural prejudices, absence of profit motive, wide separation of arable farming from nomadic livestock-keeping, shortage of land/ abundance of land, shortage of water/ grazing, unsuitable soils/ terrain, agriculture based on shifting cultivation (Figure 4), and existing labour systems (including slavery, up to the 20<sup>th</sup> century AD). These elements are discussed in subsequent chapters.



*Figure 4: Woman (with baby) hand-cultivating near Ouagadougou, Burkina Faso (© JG Burkina Faso 2013)*

#### The case of Ethiopia

A notable exception to the scarcity of working animals in sub-Saharan Africa until recent times is Ethiopia. This large country has a growing human population of 80-100 million, 7-8 million oxen (Starkey 2011:12/33), and a growing donkey population of c.6.5 million (Donkey Sanctuary pers. comm. 2014, Valette 2014:18).

Mechanisation of ploughing and transport activities is very low, and there is considerable NGO focus on working animals. The 'maresha' wooden ard-plough is thought to have been used here for at least 3,000 or even 5,000 years, possibly brought in from Egypt/ Arabia or developed independently (APP II.41). Goody (1976:109) suggests that the very early adoption of ploughing reflects the country's character as 'African in a geographical but not in a social sense', with long-established links with North Africa and Western Asia (Lhoste 2004:128, Renger 1990:273). Kjaerby (1983:131) remarks 'I am not fully aware of the reasons why it has not spread out from Ethiopia and North Africa, but one of them must be the desert preventing direct, permanent contact between the peasantries to the north and south.' Meanwhile, although the natural distribution of wild donkeys crosses the northern Ethiopia border (APP II.41), it is considered that donkeys were not initially domesticated here (Kjaerby 1983:350). Egyptian texts from c.2,270 BC report pack-

donkey caravans between Egypt and Punt (Ethiopia) (APP II.41), but significant use within Ethiopia is not detected before the end of the 1<sup>st</sup> millennium BC.

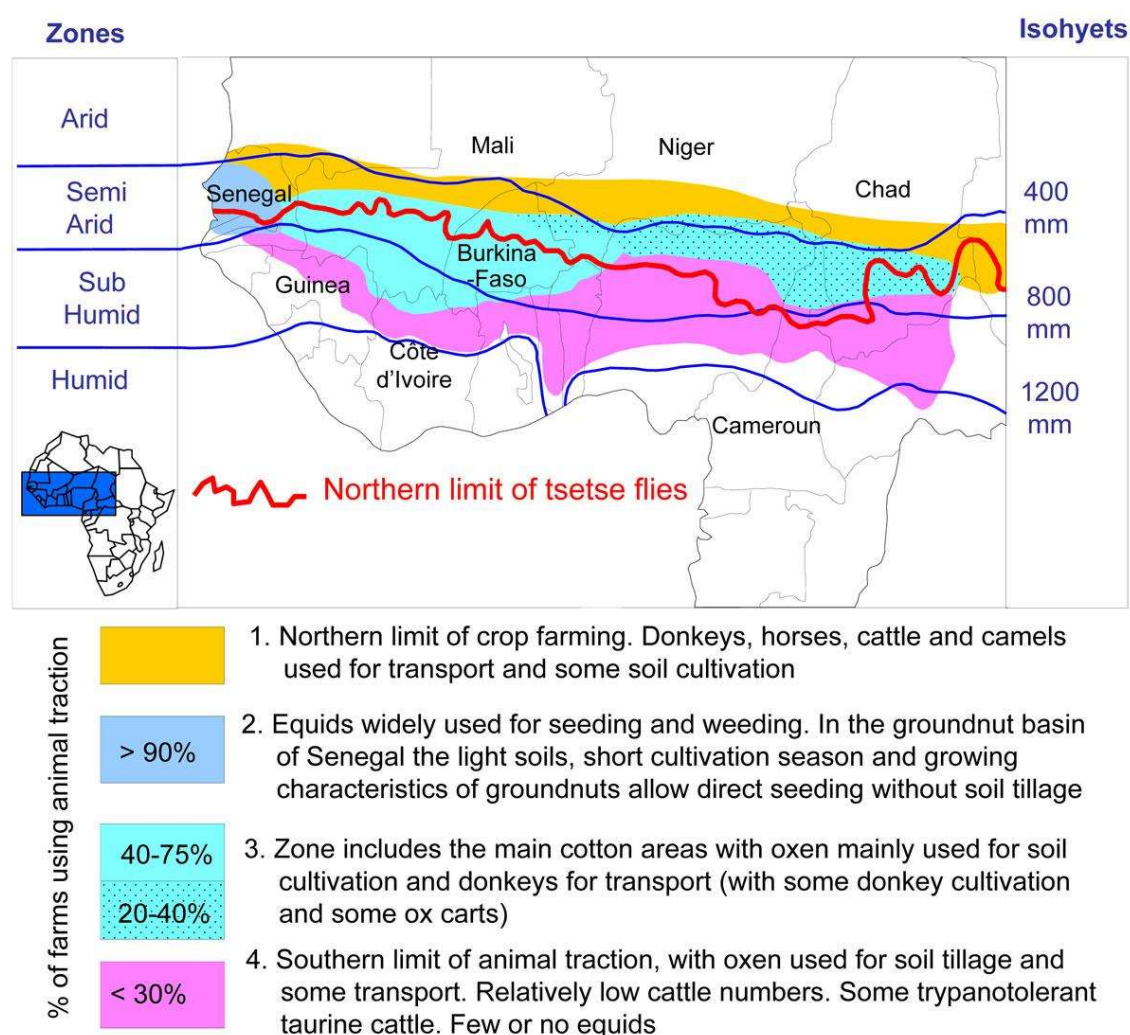


Figure 5: Map of working-animal use in West Africa, showing climate and trypanosomiasis zones (Starkey 2011:36 (after Havard et al. 2009), by permission); trypanosomiasis is carried by tsetse fly and affects humans, cattle and equids

### Colonial working-animal introduction initiatives

Elsewhere in sub-Saharan Africa, in the 20<sup>th</sup> century AD under various colonial regimes draught cattle were introduced into a number of regions, driven by a new emphasis on cash crops such as cotton and peanut (APP II.41). Both early and later initiatives often faltered or failed as a result of poor research, planning and cultural understanding: equipment was heavy and inappropriate, cattle died from trypanosomiasis (see Figure 5), additional factors such as labour for other activities were not taken into account, too many changes were introduced at once, and

adoption was hampered in some regions by heavy-handed regulation on local groups to protect the income of European settlers (APP II.41). Boserup ([1965] 2005:65) concurs that in many parts of the world colonial and independent governments drove overly towards commercial crops, but also blames the over-theoretical advice given and (p66) advisors often seeming 'to take it for granted that the cultivators have a preference for regular employment and are willing to give up seasonal leisure for a very modest compensation in additional output.' This subject is discussed further in Chapter V.4.

In some regions, these productivity-led initiatives then developed post-war into an emphasis on mechanisation, and this intensified in the post-colonial era as new governments worked to establish their modernising credentials (APP II.41); it took the 1973 oil crisis to bring home the inflexibility of developed-world combustion-engine driven solutions to African agricultural development (APP II.41). Cattle traction initiatives then started or revived in the 1970s/1980s, both in regions where tractors and/ or animal traction had been tried and in areas without experience beyond hoe agriculture. Kjaerby (1983:141) describes for example how in Tanzania ox-plough cultivation increased at this time, due to reduced tractor use and also to moves from shifting cultivation, the decline in soil fertility and yields with the consequent annexation of grazing lands, and scarce off-farm employment. By the start of the 21<sup>st</sup> century AD hoe agriculture still predominated in sub-Saharan Africa but – as a result of the new mindsets – animal traction had become significantly more widely used than mechanical means (e.g. Vall *et al.* 2002b:117). Economically-challenged government authorities in various regions have now been reducing economic support for animal traction, with challenges being addressed instead by NGOs and the private sector (Lhoste 2004:128-9). Tibbs (1989:3) alerts us to the attitude of organisations such as the World Bank, who in 1987 explicitly withheld research funding “[b]ecause of the simplicity of animal draft technology” which therefore was not perceived as requiring it. Tibbs comments that ‘[a]nimals are far more complicated than tractors and, fully integrated, their utilization has a much more profound effect on the farm system.’

#### Official working-animal drives and subsequent local adaptations

Meanwhile, as described above, initiatives by authorities still tended to distort natural adoption and expansion of the most locally-suitable agricultural and rural transport systems, and to ignore established local practices such as use of donkeys (APP II.41). Several commentators underline how adopters of working animals for

ploughing may in practice take more interest in their use for farm transport or for income-earning transportation for others, particularly in the case of donkeys (APP II.41). Transport activity generally heightened with the advent of ploughing animals, as described in Chapter VII.1; Clutton-Brock (2012:116) suggested that '[u]ntil the European incursions of southern Africa, the majority of indigenous pastoralists and farmers had no need of animals for transport'. Starkey (1994a:75) reports how some African farmers, having been encouraged to invest in animals for ploughing, return to manual cultivation and use their animals instead for profitable work transporting for others; in Zambia (Lubumbe 1994:367), farmers given oxen on a loan basis for ploughing instead used them 'almost entirely for transportation in order to earn enough money to pay back their loans in the shortest possible time'. Authorities focusing on cash crops and a specific agricultural model made vain attempts to stem this shift: in Ivory Coast at one point ox-carts were even not issued to farmers because their use would divert cattle from use in cotton cultivation (Landais and Lhoste 1990:222).

There has been a good deal of development literature recently about the complex and unexpected paths that working-animal use is taking now that the focus on imposition of Northern European models – with emphasis on investment in a pair of oxen – has lessened. Although in some areas a drive to modern mechanical options persists (Blench 2012), with the more recent advent of flexible local systems (Barrett *et al.* 1982:25/33, Havard *et al.* 2007:32) there has been a steady process in some regions of farmers switching from cattle to donkeys (APP II.13), preferring them for their low purchase and maintenance cost and greater suitability for the light ground preparation and general pack functions that form the basis of the African farmer's activities (Starkey 1992:21, Vall *et al.* 2002b:120, and see Chapter VIII.1).

### ***Use of ethnography for study of working-animal use in prehistoric cultures***

#### Improving intelligibility, reducing variables

What is the validity of using such modern studies? The use of ethnographies for study of ancient societies is an established approach, valuable in addressing potential bias and gaps by providing dimensions beyond the individual present-day experience that may subconsciously inform our deliberations (Albarella 2011:1, Johnson 1999:48, Roux 2007:153). Sensitively used, they can explore the range of responses to situations, possible behaviours and interpretations (Crawford

1978:130-1, Levine 1999a:35, Wendrich and Barnard 2008:14), identifying key variables (Cribb 1991:5) and assisting in 'eliminating error and assessing likelihood, improving credibility and delimiting uncertainty' (Wylie 2002:145). Even contrasts are valuable. Holtorf (2000:165) reminds us that '[t]he aim of archaeological interpretation is not to produce 'true' statements about the past, but to evoke intelligibility of the past and its remains in the past'. Ethnographic studies can be used both in creating 'explanatory hypotheses for specific items or patterns recovered archaeologically' (Gould and Watson 1982:356) and in constructing broader models. Shennan (2004) argues that in order to leap beyond mere 'plausibility' (p4) in interpreting the actions relating to archaeological assemblages, there is significant value in hearing from 'someone who knows how to do it' (p17).

#### Looking beyond Westerncentric preconceptions

In many of the recent studies by developed-world and locally-based agencies in Africa and elsewhere there has been an explicit intention to move away from northern European priorities and to establish local needs and practices with close attention to suitability of solutions to the local environment and farming traditions. This offers archaeologists the opportunity to reassess the often Westerncentric epistemology of early working animal use in the Near East, where there is little challenge to assumptions such as that decisions, by animal-users and others, were always directed towards greater utility, productivity and profitability in developed-world terms (Hodder 1982:211, Russell 1988:7, Wylie 2002:145 and APP II.31). Oma (2007a:1) suggests that study of animals in the human sphere has been caught between 'the cost-benefit thinking of modern industrial farming' and 'symbolically oriented archaeology motivated by anthropology'. Porter (2012:6) argues similarly that 'we have, by and large, nicely reconstructed an understanding of what life would have been like if we had existed in the past. That is to say, none of the categories that currently dominate our thinking are quite real for antiquity.'

#### An ethological approach

Certainly account should be taken of influences such as political frameworks then and now (Finkelstein and Perevolotsky 1992:81), modern technologies (Rosen 1992:79) and the past and present roles of religion/ taboo/ prestige and traditions (Johnson 1969:99, Orev 1972:236). Modern human study subjects, too, are rarely free from some form of contamination, by Government subsidies, new employment patterns, and interaction with other societies. Observation studies of the operation of animal-based traction and transport offer a useful advantage in that some of the

unavoidable shortcomings of ethnographic field interviewing can be rectified by ethology – the study of innate animal behaviour and natural psychological responses to situations. 'However obvious this may seem, it is particularly important that zooarchaeologists do not forget that they deal with remains of what once were living creatures' (Albarella 2011:2). This approach provides in addition 'the short duration necessary for discovering the mechanisms underlying technological changes in different settings' (Roux 2007:171), as in Wylie's (2002:141) suggestion that analogy can provide a more reliable 'reconstruction of strictly technical or technically-determined realms' than of the activities of humans. Hodder (1982:210) underlines the greater reliability of 'relational' analogies based on 'natural, physical and chemical' laws and processes which link the present and the past. Seeking these irreducibles, Gould and Watson (1982:362) advocate 'incorporating natural science principles as much as possible', with the emphasis on 'the biological characteristics of human beings and human societies'. This approach, when employed in reconstructing the physical and cultural world of working animals in the past, has the advantage of paralleling the direct process employed by human users of the time, who actively engaged and built on animals' physiological and behavioural capabilities.

## II WORKING ANIMALS IN ANTIQUITY

### II.1 The adoption of working animals in the Ancient Near East

#### *Domestication of animals for work: a new paradigm*

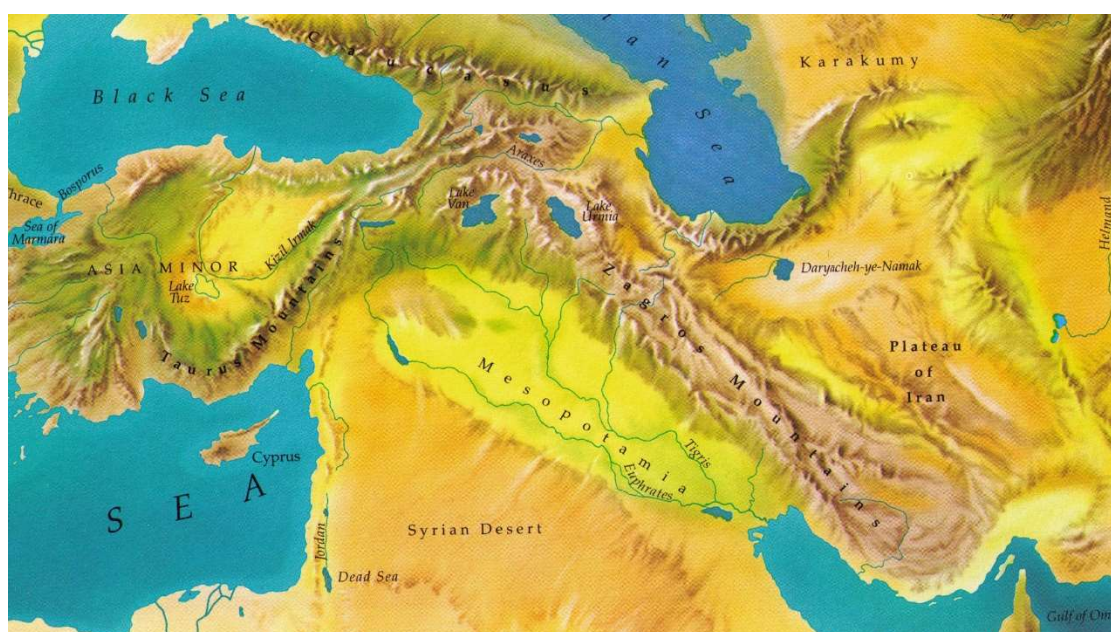
Domestication of animals for work constituted a new paradigm in human-animal relations, with a new focus on living individuals and the means of obtaining their cooperation (Jones 2008a, Meadow 1984:310), requiring entirely new skills in training and handling (Chapter IV.2). Key to acceptance by animals of domestication in general is the relationship between their new role and their natural pattern of behaviour in the wild (see APP II.30 for references to works on domestication), as well as their physiology (see Chapter III.1), and behaviourists suggest that there is even an element of mutual benefit in this acceptance process (O'Connor 1997, Russell 2012:211). As with many other domesticated species, cattle and donkeys bond with other group members in the wild as a survival tactic (see Chapter III.1), and the shift to bonding with humans can be enhanced through breaking of group hierarchies and by close association (APP II.30). Where natural behaviour patterns do not lend themselves to bonding with humans, 'the suitable evolutionary response was not elicited' (Larson and Fuller 2014:120) and species such as gazelle and onager were not domesticated.

There is extensive specialist literature on the phenomenon and process of early taming and domestication of animals for work, as of domestication for meat, and I do not propose to enter into these, nor into the debate on motivations such as the need to grow and transport food surpluses to support urbanised specialists (e.g. Boserup 1965); the focus of this thesis is on the impact of domesticated donkeys and cattle as an established presence, and the outlines in the present chapter of the timing and location of the early domestication for work of cattle and donkeys comprise an introductory background, as a context for the arguments in the main body of this document. Separately, the detection of early domestication for work is an evolving discipline, with faunal remains analysis being newly supported by genetic studies, and with isotopic, archaeobotanical and dung analyses providing new angles of approach; these are outlined briefly in Chapter IX.1.



### ***Working animals in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia***

The systematic adoption of animals for work in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC developed in specific social and economic environments including Mesopotamia, the southern Levant, Egypt and Europe. Of these, the former three regions had access to the donkey – a key element of the ‘stable’ of working animals that persists to this day. In a full analysis of the advent of working cattle and donkeys all three Ancient Near Eastern regions should be represented – and all are discussed in this document – but for compactness of argument I shall focus chiefly on examination of their impact in one region, 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia (Figure 6).



*Figure 6: Mesopotamia (extract from Times Atlas of the World 1995:43. © Collins Bartholomew 1995, by permission)*

#### **Background to working-animal use in Mesopotamia**

The rapid development of social complexity and wide regional influence which branded the Uruk period is one of the weightiest subjects for debate among scholars of this period, and I am not qualified to address it here, in a thesis firmly focused on day-to-day activities relating to systematic working-animal adoption; but I provide here a brief overview.

The limited archaeological evidence available for the 6<sup>th</sup>-5<sup>th</sup> millennia BC indicates that the Ubaid cultural era, in southern Mesopotamia and in contemporary but perhaps separate manifestations in the north (Carter and Philip 2010:6-7, Karsgaard

2010:52), contained the seeds of social stratification and urbanisation but had not coalesced into a state entity. While earlier arguments posited the Ubaid as an immediate precursor to the state development of the 4<sup>th</sup>-millennium BC Uruk, newer evidence indicates a less direct path (Carter and Philip 2010:8-10). Pournelle (2003:83) also revises established thinking on the landscape and agriculture of southern Mesopotamia at this time – typically modelled as irrigation-fed agriculture employing oxen for traction – with her satellite-imagery based model of an intricate wetland hinterland from which the emerging cities derived a significant part of their resources.

### The Uruk period

The urban development of the Uruk period (c.3900-3200 BC) rested on organisational systems controlling the flow of goods and information, culminating by the late Uruk in the emergence of cuneiform writing for bureaucratic administrators, for whom '[the] higher level of competence and flexibility of dealing with complex problems acquired during these processes becomes the main asset' (Nissen 2002:15). Control of the rapidly-growing urban population was conducted through 'new forms of organizing labor that delivered economies of scale in the production of subsistence and industrial commodities to southern societies' (Algaze 2008:9), including for the management and use of working animals for ploughing and transport (Shenk *et al.* 2010:66, Sherratt 1981:293-5). The complexity involved in this new social process generated an elite responsible for the acceleration of demand for monumental architecture and luxury goods, and a lower class of encumbered workers and captives – the latter's social position demonstrated by the similar terminology in the late 4<sup>th</sup> millennium BC Uruk Archaic Texts for these and domestic animals (APP II.30).

An expansion of Uruk interests and culture beyond their original borders is detected in the Susiana plain in south-western Iran in the first half of the 4<sup>th</sup> millennium BC (Algaze 2013:82). In the mid-Uruk, a range of outposts and transshipment centres relating to the southern core then developed in north and north-eastern Mesopotamia (some references are noted in APP II.22), often concentrated at east-west transport route intersection points with major rivers and at the base of mountain routes (Matthews and Fazeli 2004:70), with smaller way-stations between.

### The northern powerhouse

The marked refocusing of archaeological fieldwork onto northern Mesopotamia in more recent times has led to a reassessment of the development of urbanisation and complexity here, formerly considered to stem from southern influence but now recognised as featuring significant indigenous technological and cultural sophistication (Oates *et al.* 2007:585, Porter 2012:76), in some cases predating cultural and economic expansion initiatives from the south (Weiss 1986:1). Porter (2012:1/10) argues cogently for the role of pastoralist groups (often dismissed in traditional models as solely preceding or peripheral to the sedentary 'rulers'; see also Chapter VIII.4) as an integral element of the society generating both southern and northern developments.

The early 3<sup>rd</sup> millennium BC then saw a significant regression in the north, contrasting with the continuing urbanisation in the south. A second phase then emerged in the north, with a '[r]esurgence of urbanism and complexity, c. 2600-2000 BC' (Ur 2010:404) featuring rapid urbanisation with a significant impact on agriculture and animal husbandry. Similarly, a renewed wave of urbanisation took place in the south from the mid 3<sup>rd</sup> millennium BC, culminating in the late 3<sup>rd</sup>-millennium BC Ur III period with its highly centralised state economic system, controlling agricultural resources, and eventual urban collapse.

#### Rethinking working-animal models

As outlined below in the context of Sherratt's secondary-products model, the ploughing ox has become closely associated with the later Uruk as an enabler of centrally-controlled production of an irrigation-based agricultural surplus upon which the new social complexity depended for its survival (e.g. Sherratt 1981:290–298, 2006:343); but new evidence from modern analogy in particular is suggesting a less direct and causative relationship, as discussed in Chapters V.4-5. Wheeled vehicles, as epitomised by the famous Uruk-period pictographs (referenced in APP II.18; see Figure 40), are also an emblematic feature of the Uruk phenomenon; but Sherratt (2003:243/247) and others (APP II.18) conclude that wheeled vehicles at this early period are principally for ritual or prestige use, with pack or dragging being a more cost-effective and practical means of transport in daily life (see Chapter VII.2 on carts).

Meanwhile, as expanded upon below and in Chapter VII.3, there is now growing recognition among commentators of the role of the donkey from the late 4<sup>th</sup> millennium BC, as a valuable complementary technology to the water transport

considered central to the operation of South Mesopotamian trade, distribution and manufacturing, and in due course as an established alternative ploughing animal. As discussed in Chapters II.2 and IV.1 on supply of donkeys, contemporary pastoralist groups may have been early users of donkeys for pack. Anne Porter's proposal above of the key role of pastoralists in Mesopotamian state formation provides an attractive indication of how donkey-use might have filtered into an urbanising culture with rapidly-growing need for work capacity. Zarins (2014:198) proposes the adoption of the pack donkey as a causal factor in the urbanisation and long-distance trade that is a feature of the Uruk phenomenon, but admits that the chronology points to the donkey as more of a significant supporting factor, taken on late in the 4<sup>th</sup> millennium BC as a new tool for intensification of existing developments. Brodie (2008) suggests a very similar scenario in the Bronze Age Aegean:

[t]he donkey itself was not an agent of change, nor was it an immediate cause of settlement nucleation or overland trade. It provided a resource that could be drawn upon by communities to provide previously unavailable responses to changing socio-economic and ecological circumstances. (Brodie 2008:304)

Larson and Fuller (2014:126) imply a similar point with their argument that the domestication of pack donkeys (and later camels) 'is entangled with the expansion of trade and agriculture into new regions' rather than forming a primary cause. Kreike (2010:7) warns against models of donkey adoption in modern Africa resting on the 'assumption that new technology automatically creates its own demand because it is inherently and transparently superior': the phenomenon of animal power lay in its utility for fulfilling burgeoning demand, not necessarily in generating it.

### ***The Mesopotamian 'private sector'***

In the spheres of both agriculture and urban-led activities such as long-distance trade, under the better-documented state institutions of Sumer/ southern Mesopotamia there is evidence that a layer of privately-operated enterprises existed, from small-scale farming to independent merchants (see APP II.35 for sources discussing indications of their presence), rarely recorded by the 3<sup>rd</sup>-millennium BC cuneiform texts. Pollock *et al.* (1996) argue that dispersed, small-

scale production of goods, foodstuffs and animals fed into a centrally-organised distribution system:

[s]ome researchers have argued that Uruk polities were dominated by a centralized and hierarchically organized administrative system, in which state institutions controlled large-scale economic activities, including the production and distribution of goods. In a contrasting argument, the notion of a centrally administered economy has been contested, and economic activities are regarded as more regionally specialized and diverse, with town-based institutions acting primarily to facilitate the reciprocal exchange of goods and services among specialist producers. (Pollock *et al.* 1996:683)

Asher-Greve (2013:359) points out that '[t]he economic foundation of Mesopotamian polities was agriculture and animal husbandry; most Sumerians and their Semitic neighbours were rural, but nearly all our sources come from cities.' Adams (2008:1) argues that the body of texts from which we draw most of our information 'simply ignores the conditions of life of the vast majority', Stone (2007:216) adding that it is 'certainly biased toward those whose activities were deemed worthy of transcription and against the poor and the weak. It is also dominated by records of the activities and points of view of urban residents'. Stone (1999:204-12) sees the hierarchical authorities as controlling the provision of arable land, leaving the less accessible or reliable areas for a population delivering crops (and temporary labour) to urban authorities but able to operate smallholdings independently, augmented by exploitation of marsh and desert flora and fauna (Stone 1999:206). Styring *et al.* (2017:9) argue from extensive new analyses of isotopic and other evidence in Syria that

although our data are consistent with an overall strategy of extensification, this broader framework subsumes a range of behavioural variation that is testimony to a bottom-up as opposed to top-down driver of agricultural change. Individual households seem to have practiced a nuanced and flexible strategy in which (1) the crops planted, (2) where they were planted and (3) labour and material inputs of water and/or manure were all fine-tuned to the specific characteristics of the crop, land and/or soil quality, and the highly variable rainfall circumstances of any given year. This diversity in agricultural practice makes sense as a household risk-buffering strategy but not as an elite-controlled share-cropping regime.



*Figure 7: Ziniaré, Ouagadougou region, Burkina Faso: an African farming hamlet with grain silos (© JG Burkina Faso 2013). One silo has been opened to make dolo beer*

Adams' (1981:136-41) seminal report on his survey of the Iraq countryside underlines the apparent scarcity of small rural settlements in the 3<sup>rd</sup> millennium BC, but Steinkeller (2007) considers that this is a function of their low archaeological footprint, citing texts from late 3<sup>rd</sup>-millennium BC Umma recording large numbers of hamlets with a grain silo (see Figure 7) and a threshing-floor where grain was processed – presumably by inhabitants – before forwarding to urban centres. Pournelle reports (2003:84) on the valuable expansion in recent years of Adams' survey initiatives in southern Mesopotamia through new extensive regional surveys, and Cooper (2006:52) on similar work in some regions of the north. Adams (2001:346) agrees that 'doubts linger about how closely gradations of control over human and other resources' can be detected from material vestiges, and notes (2008:12-14, with Liverani 2006:35) that in the 3<sup>rd</sup> millennium BC urban house-plots, date-palm groves and vegetable plots are known to have been privately held and the products exchanged without regulation, while labour patterns in texts from Umma indicate significant capacity used outside the state or temple system. Gelb *et al.* (1991:2) and Liverani (1996:13) report on inscriptions on stone boundary-markers and a range of texts indicating private land sales in the 3<sup>rd</sup> millennium BC, particularly in northern Mesopotamia. In the latter region, McMahon (2013) suggests that

[t]here may have been a dual economy: mixed household versus specialised institutional. This variability makes the north's agricultural economy appear more flexible and less regulated than Sumer's. However, we have unequal

data: botanical remains are poorly preserved in Sumer due to salinisation, and there we rely heavily on texts, with their strong administrative focus, for reconstruction of the agricultural system. Sumer may have had equal flexibility, risk-spreading and crop choice below the administrative radar. (McMahon 2013:470)

Throughout history there have also been initiatives to conceal assets from the eye of authorities, as for example with enterprising agricultural producers in modern Senegal and Ivory Coast who 'launder' their crop surplus into cattle which are then kept outside the village to avoid taxation or sequestration (Landais and Lhoste 1990:228).

In a later text, the early 2<sup>nd</sup>-millennium BC poem of *The Debate Between the Hoe and the Plough* (also known as *The Disputation Between the Hoe and the Plough*), the two agricultural modes are debated: the Plough boasts that it is highly-regarded by the elite and delivers much greater grain output than the Hoe, but the humble Hoe prevails as not only does it make furrows as well as the Plough but has multiple other uses (Black *et al.* 1998-2006a). While the Sumerian texts clearly indicate massive centralised agricultural operations (e.g. Charles 1990:47-9, LaPlaca and Powell 1990:81), the continuing importance of the hoe and the archaeobotanical record of that period show a more diverse agricultural picture (Ellison 1982:180, Halstead 1995:19), as would be expected in the presence of smallholdings. Shenk *et al.* (2010:66) point out that in complex societies 'the majority of people in such cultures may continue to live in rural areas and/or work in agriculture', and Renger (1990) concludes that it is valid to make some comparisons of use of draught oxen in sub-Saharan Africa with late 3<sup>rd</sup>- and 2<sup>nd</sup>-millennium BC Sumerian and Akkadian texts in the areas of

training, guidance, feeding and care, and the number of animals drawing a plow. In all four of them the human factor is decisive for increasing the effectiveness of animal power. (Renger 1990:275)

Meanwhile, Algaze (2007:346), Foster (1977:31-3) and Lamberg-Karlovsky (1996:75-6/86-8) report on textual analyses indicating large-scale private trading in later 3<sup>rd</sup>-millennium BC Mesopotamia of a range of items; 'an asymmetry in the evidence between the texts and the archaeological record' (Lamberg-Karlovsky 1996:86) suggests perhaps large-scale unrecorded activities, for example of pack donkeys.



In this thesis, as I explain in my research aims (Chapter I.1), I aim to consider the implications of this 'private sector' activity as an additional facet of the overall model of Mesopotamian agriculture and transport, by examining patterns of working-animal use in modern developing regions where decisions are made individually and choices reflect household-level needs. As I discuss later, small-scale farming can feature greater emphasis on use of (female) cows and donkeys rather than higher-cost oxen. Tibbs (1989:52-4) reports on donkeys in China as indicators of individual ownership of land: the population of donkeys surged after the 1949 AD redistribution of land to individuals, but then reduced from 1952 as collectivisation (and also mechanisation) took hold, with a new increase from 1978 as new agricultural policies favoured individual ownership of working animals. In Mesopotamia donkeys had begun passing through the countryside on pack journeys as well as being potentially available from mobile pastoral groups interacting with agriculturalists. Cows were an established presence in the agricultural landscape, a resource-efficient asset for small farmers (see Chapter III.2) and as up to the present day an option for ploughing.

### ***Sherratt's secondary-products model, and a new focus on donkeys and cows***

Following long-running scholarly debate on the origins and dating of early ploughing and wheel use, Sherratt (1981, 1983, 1987, 1997a, 1997b, 1997c, 1997d, 2003, 2006) led working animals into the centre of the prehistoric archaeological arena with his far-reaching theory concerning the advent of secondary products – traction, milk and wool – in the 4<sup>th</sup> millennium BC (Figure 8). He originally argued that these products were evolved or adopted as a package, including an ox-plough/ cart 'traction complex, with its own technology, ideology, and attitude to domestic livestock' (Sherratt 1997d:240; oxen being castrated male cattle) with a distinct but roughly contemporary enlistment of equids for long-distance pack transport (Sherratt 1981:295). Sherratt (1981:262/299) also drew social evolutionary elements from Goody's (1976) analysis of Murdock's (1967) *Ethnographic Atlas*, linking cattle-herding and ox-ploughing with new land-based inheritance structures and with the exclusion of women from economic and social power.



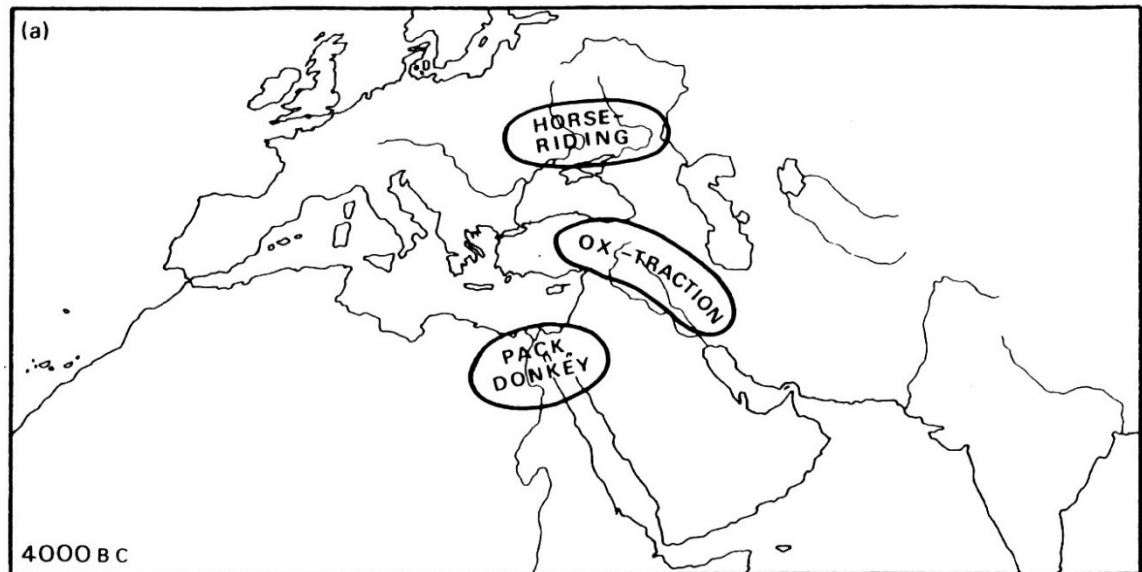


Figure 8: Sherratt's (1981:288) ox-centric view of early working animal use in Mesopotamia (by kind permission of Sue Sherratt)

#### Original model and modifications

Sherratt's model focused on the transmission of specific hardware – the plough and the cart – between the Near East, Europe and the Central Asian steppe in approximately the 4<sup>th</sup> millennium BC (Sherratt 1981:266/288). Sherratt initially included the horse in his model (1981:272-4), suggesting a steppe 'package' of horse and ox-cart (the former for herding, the latter for transport of households to follow the herds (Anthony 1991:266)) and this may well have influenced Sherratt's focus on ox-carts rather than pack-donkeys for transport in Mesopotamia (Sherratt 1981:295). However, he (1997a:31) later withdrew horses from his scenario. Sherratt's model does not specifically address the development of animal-based transport (with or without carts), and by the 1970s/80s little had been published on the likely presence of the domesticated donkey in Mesopotamia, so it did not form part of his interpretation. Chapter VII.3 describes earlier dismissal by commentators of the importance to Mesopotamia of donkey caravans, now increasingly replaced by recognition of their key role alongside boat transport.

Archaeological thought now – while acknowledging the highly significant impact on human society of the use of working animals – generally takes the view that there was not a moment of innovation or a package involving the close interrelation of several secondary products and traction modes diffusing as a unit. Vigne and Helmer (2007:34-5) consider that Sherratt undervalued the technical ingenuity of earlier cultures, suggesting that a more intricate evolution of human-animal

relationships took place in which cattle were managed early on for milk and even work, with hunting still the primary source of meat. Additionally, Sherratt's traction complex focused on cattle, linking them firmly with the plough and the cart, with donkeys mentioned only as working on the southern Levant/ Egypt pack routes (Sherratt 1983:96, though with later acknowledgement of their spread to Mesopotamia (2003:238)). A new deconstruction, based on more robust zooarchaeological and archaeobotanical evidence (Halstead and Isaakidou 2011:61-2, Isaakidou 2006:107), now allows us to separate out working animals for traction and transport from the package, and from elite vehicles (see above), and to examine their specific social and economic impact upon society.

#### Post-Sherratt use of modern analogy

Two key initial players in this new focus on working animals, post Sherratt's original 1981 work, were Bogucki (1993) and Halstead (1995). Bogucki comments about archaeological approaches to working animals that

there is a longstanding bias towards viewing livestock as subsistence resources, with far less consideration given to their economic roles while living. This bias is understandable, for faunal remains are archaeological data and prehistoric living animals are abstract concepts. While the concept of 'secondary products' has addressed this issue to some degree, there is still a tendency to think in terms of 'products' rather than viewing animals as 'assets' in the Neolithic economy. (Bogucki 1993:492)

As noted in Chapters 1.1-2 above, he uses analogies from studies from modern Africa to discuss at household level the advantages of ox-ploughing for owners (citing Barrett *et al.* 1982, McCann 1984, Singh 1988) and the disadvantages for non-owners (citing Peters 1986), concluding that working animal ownership can lead to wealth disparity. Halstead (1995) again uses modern observations, from studies in Greece among traditional farmers; he discusses Gilman's (1991) and Goody's (1976) assertions that ox-ploughing leads to social inequality, but concludes from his own studies that social inequality is also a precondition for plough-ox adoption as only larger farms can show a net benefit. As I underline in my research aims, these findings suggest rich fields of further enquiry – as yet little taken up by archaeologists – into the impact of animal ploughing on individual households and on societies generally, with the aid of selected modern analogy.

#### Persisting focus on (male) cattle and wheeled vehicles

Both commentators built upon Sherratt's model, maintaining the emphasis on cattle for ploughing; both discussed Europe but have been habitually cited by commentators on the Ancient Near East despite wide differences of soil, terrain and available animals. Sherratt (2006:351-2) does comment on the different evolution of the plough itself in the damp, heavy soils of Europe compared with those of Mesopotamia and Egypt, but not on corresponding differences in animal use apart from a brief reference (2006:336) to the unsuitability of (female) cows for traction in 4<sup>th</sup>-millennium BC Europe. Thus in many discussions of early working animal use in the Ancient Near East in particular a mindset persists in which ploughing and by extension all agricultural work is carried out with (male) cattle (Sherratt and other references are listed in APP II.30). I discuss anthropological commentaries (which almost universally assume ox-ploughing) on the social and economic implications of the adoption of animal-ploughing in Chapters V.5 (on fallibilities in Boserup's 1965 model of relationships between yield, labour and land) and VIII.2 (on the relationship with inequality).

Local transportation, if mentioned in archaeological commentary, is also still too often casually associated with the wheel (for example Scott 2017:205), betraying perhaps a modern European bias and possibly preconceptions from analogy with the 4<sup>th</sup>-millennium BC development of ox-carts on the Central Asian steppe (Anthony 1991:266). As discussed in Chapter VII.1, the use of animals for local pack, or at least for dragging items, is a far more likely early transport option in a region short of wood, roads and bridges; and the multi-purpose donkey, available for both local transport and ploughing, is central to many modern household economies in developing countries, as discussed throughout this thesis.

#### The case for donkeys and female cows

This bias has contributed to the neglect until recently of study of the impact of both donkeys and cows as plough animals in antiquity, despite the common worldwide use of both today for ploughing in arid, light soils in particular. While official Mesopotamian texts and depictions, recording state-controlled agricultural activities, seemingly refer largely to oxen, donkeys are nevertheless mentioned as regularly used for ploughing from the 3<sup>rd</sup> millennium BC (Figure 58), and commentators are now highlighting the evidence of use in antiquity too of cows for ploughing. Cattle skeleton pathologies at Knossos indicate that cows were used for ploughing there from at least the 6<sup>th</sup> millennium BC (e.g. Isaakidou 2011:101-3), and cows have been the ploughing animals in Egypt from antiquity (Chapter III.2).

In Chapter III.2 I underline that use of working cows can be less visible zooarchaeologically than with oxen. Archaeological detection of working donkey use can also be problematic: there is evidence from Egypt (e.g. Rossel *et al.* 2008:3715) and elsewhere that working donkeys were not necessarily morphologically different from wild ones apart from load-bearing pathologies (Chapter IV.1), and zooarchaeological evidence is scarce as it appears that donkeys were not commonly eaten (Chapter IV.2), and their carcasses may well as today be dragged outside settlements (APP II.12); where remains are found, key skeletal elements may be missing, and in the general circumstances of limited comparison material for domesticated donkeys, interpretation of pathologies is also a concern. Zarins (2014) sums up the resulting conundrum for the detection of working donkeys:

[g]iven such a purpose for this equid, its remains would not turn up in house or public building refuse dumps and debris unless fortuitous circumstances happened to occur, e.g. in the case of the Abu Salabikh dump donkey. In smaller village complexes one might argue that domestic animals were kept in separate units attached to the basic overall dwelling unit, but in a large urban context these specialized animals were tended by shepherds in the fields or kept in paddocks outside of the city. This is quite clear from the cuneiform evidence. Therefore, in a large-scale excavation within an urban area, unless the excavator deliberately was looking for stables, stalls, burials, etc., the remains of the pack donkeys ... would not turn up. (Zarins 2014:82)

## **II.2 History of domestication of working animals in the Ancient Near East**

This chapter provides brief background information on the trajectory of cattle and donkeys towards their roles as working animals in the Ancient Near East. My focus throughout this thesis is on their emergence in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, though with supporting commentary on contemporary southern Levant and Egypt. A particular phenomenon to be considered is the dichotomy between the despised status of the working donkey from earliest times and the widespread incidence of burial of pairs of donkeys in elite circumstances. As noted above, I include only brief notes on onager-donkey hybrid production in Mesopotamia and on the advent of the horse.

### ***Domestication of cattle, and early use for work***

While donkeys were domesticated primarily for work, the majority (though not unchallenged) view is that cattle were initially domesticated for meat, in the 8<sup>th</sup> or even 9<sup>th</sup> millennium BC in the Ancient Near East (APP II.30). As defined earlier, my focus in this thesis is on the time of systematic and established employment of working animals, to the extent that significant economic and social impacts might be detectable in the archaeological record. Early domestication is therefore outside my scope, as is the evolving debate on earliest use of cattle for traction. Sherratt took the view that although localised adoption of ploughing with cattle took place in Mesopotamia from perhaps the 6<sup>th</sup> millennium BC (e.g. Sherratt 1983:98, 1987a:2), with some possible earlier use for threshing (Sherratt 2006:342-3), the systematic use of yoked oxen for ploughing emerged rapidly in the 4<sup>th</sup> millennium BC with the arising of the Uruk civilisation, with its ability to support such an investment-heavy development (Sherratt 1981:263, 2003:242-3, 2006:333).

The sign for a plough is seen in the earliest texts in the late 4<sup>th</sup> millennium BC, and Mesopotamian depictions and texts from then on indicate major centralised ploughing operations for sowing and irrigation work (APP II.32). The initial use of oxen is more assumed than indicated: Englund points out that in the earliest texts

[o]nly several uncertain accounts register together the existence of both the plow represented by the sign APIN and oxen represented by the sign GU<sub>4</sub>. Whether oxen played a large role in field work in the Late Uruk period is thus a matter of conjecture. (Englund 1995:33)

As noted in the chapter above, early ploughing may have been carried out by cows and donkeys as well as oxen. There is growing reason – including from modern examples – to consider that the localised and piecemeal adoption of ploughing with animals (e.g. Halstead 2014:59) continued to develop in parallel in a lower trajectory, under the radar of the urban recorders (see earlier). As described in Chapter V.3, a single animal – probably a cow or a donkey – ploughing with a home-made ard fulfils the subsistence needs of a small farmer, while pairs of oxen may be more suitable for use in a centralised economy able to support the investment. Meanwhile, Chapters VII.1-2 outline the arguments against the likelihood of ox-carts forming a major transport mode in Mesopotamia in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC and underline the much greater utility of pack donkeys, and the little-discussed importance of short-distance transport in the new ploughing age.

### ***Early domestication of donkeys: zones of interaction?***

Donkeys were native to the rocky deserts of north-eastern Africa. It is suggested by some commentators (e.g. Zarins 2014:109) that the ancient range of wild donkeys extended further north and west, to the Libyan desert, and that multiple episodes of early *ad hoc* domestication may have occurred here among mobile cattle-herding groups with a need for transportation, as with camp moves (see examples in Chapter IV.2), particularly in view of increasing Saharan aridity and the need to reach more distant water sources (see references in APP II.21, and Figures 9 and 48). *Ad hoc* recruitment of donkeys remains a feature of their use in some regions today (e.g. Chapter IV.2 and APP II.14).

More intensive adoption may then have occurred where these mobile groups interacted with sedentary farmers, at the edge of the Nile valley (e.g. Larson and Fuller 2014:126, Zarins 2014:109); this interaction may be illustrated by the Libyan ‘Cities palette’ from the late 4<sup>th</sup> millennium BC (Baines 2003), depicting animals including donkeys brought as tribute by desert-dwelling groups from near the western Delta (references are listed in APP II.21). As discussed in Chapter IV.1, demand for donkeys in an area unsuitable for breeding has commonly been supplied from arid marginal regions. A promising model for the growth in systematic use of donkeys is therefore the coinciding of mobile groups making low-level use of pack donkeys with intensifying or urbanising sedentary cultures (Vilà *et al.*

2006:350, Zarins 2014:248-9), with new high demand for transportation of farm products, construction materials and trade goods. In the 4<sup>th</sup> millennium BC donkeys then became established as a central element of the arterial trade in wine and oil to Egypt from the southern Levant (APP II.36, and see Chapter VII.3).



*Figure 9: Tuareg women in Niger moving camp (© Galen Frysinger 2011, open access)*

### Mesopotamia

The earliest potential indicators of use of donkeys for work in Mesopotamia, and indeed anywhere, are a depiction on a 5<sup>th</sup>-millennium BC sherd from Fars in highland south-west Iran of a donkey with a possible blanket or pannier (see Figure 10; Potts 2011), and faunal remains from 4<sup>th</sup>-millennium BC Tell Rubeidheh on the long-distance route east from southern Mesopotamia into the Zagros mountains (Payne 1988). While there is still debate on the presence of wild *Equus asinus* in Mesopotamia (e.g. Vila 2014:433), working donkeys in this region are most likely to have been introduced as domesticates, perhaps even brought by coastal boat from Arabia (Hans-Peter Uerpmann pers. comm. 2015) or across the Mesopotamian rivers. Zarins (2014:199) reports an Old Akkadian 3<sup>rd</sup>-millennium BC text concerning donkeys and bovids transported by boat, while donkeys have been taken on rafts down the Mesopotamian rivers from early times (Chapter VII.3). In more recent times, European and other settlers took donkeys to southern Africa on their ships (Chapter I.2).



Figure 10: 5<sup>th</sup>-millennium BC sherd from Tol-e Nurabad in Western Fars, Iran (Potts 2011:170, by permission)

The presence of domesticated donkeys in Mesopotamia from the late 4<sup>th</sup> millennium BC is then suggested by faunal and other evidence (APP II.21), as discussed in Chapter VII.3; in the 3<sup>rd</sup> millennium BC, faunal, textual and representational evidence of donkey use is more common (APP II.21 and see Figure 58). In an early 3<sup>rd</sup>-millennium BC Sumerian text 'the people of Aratta stepped forward to admire the pack-asses' sent east over the mountains with grain to exchange for precious goods (Black *et al.* 1998-2006b *Enmerkar and the Lord of Aratta*); the donkeys themselves – with fewer needed for the return journey – might have formed a valuable part of the consignment. Pre-Sargonic (mid 3<sup>rd</sup> millennium BC) depictions and texts (APP II.21), and texts from late 3<sup>rd</sup>-millennium BC Umma and Girsu relating to fodder cost, inspection of plough animals and land assignment (Heimpel 1994:18/22), give evidence of the established use of donkeys for ploughing (Chapter VIII.1); Postgate (1986:200) comments 'I had not appreciated the fact that the presence of the donkey in 3<sup>rd</sup> millennium Mesopotamia, which is, I think, taken for granted by most cuneiformists, would be a matter of surprise for zoologists.'

#### Elite burials and donkey status dichotomy



Bulliet (2005:151) suggests that in Egypt donkeys might have been first captured for ritual or ceremonial use, and certainly transport animals in the Ancient Near East are frequently linked to ceremonial or sacrificial events, from the numerous apparent ceremonial draught-animal burials in the 3<sup>rd</sup> millennium BC, alone or in elite human graves, to the 2<sup>nd</sup>-millennium BC Mari texts mentioning donkey-killing to seal a treaty (APP II.21). In later 3<sup>rd</sup>- early 2<sup>nd</sup>-millennium BC texts the donkey is referred to as a noble and spirited animal, as in the poem in praise of the king Šulgi, who is famed as a fast runner and where he is depicted as

I am a mule<sup>[1]</sup>, most suitable for the road.  
 I am a horse, whose tail waves on the highway.  
 I am a donkey of Cakkan, who loves running. (Black *et al.* 1998-2006c:Šulgi A ¶16-18)  
<sup>[1]</sup> Or 'Nisku' may be translated as 'choice donkey' (Zarins 2014:175)

Zarins (2014:53-65) advises caution about some of the traditional references to the phenomenon of equid burials with high-status humans: having re-examined some of the studies and actual faunal evidence, for example the elite burials at Ur and Kish, he concludes that some of the equids were either not associated with the human burial or were entirely misidentified. On closer examination, too, equids in elite texts, representations and burials are commonly the expensive and prized hemione-donkey hybrids rather than donkeys (Postgate 1986, 194-200; Weber 2008; Zarins 1986, 185-7, and below). Separately, several commentators (APP II.21) suggest that special treatment of donkeys is, rather than ceremonial, the result of the impressive spectacle of large, fast, strong animals submitting to humans and performing valuable transport and communication work for the greater wealth and glory of their merchant or noble owner. A certain social prestige can attach to donkey ownership even in modern Africa, with its role as a valuable draught animal alongside oxen and horses (Singh 1988:161); and Greenfield *et al.* (2012:26-7) point out that donkey-burials in the 3<sup>rd</sup> millennium BC, in contrast to those in the 2<sup>nd</sup> millennium BC, are often not associated with temples or monumental structures. A conundrum throughout history is the positioning of the donkey as simultaneously elite and despised; Milevski's (2011:233) hypothesis of elite human burials with donkeys as relating to merchants, further developed by Greenfield *et al.* (2012:25) and Shai *et al.* (2016:6-7), may help to resolve this. Donkeys were a valuable resource to merchants benefiting economically and socially from their ability to move goods long-distance at low cost, and so while lowly and despised in themselves a symbolic pair from the 'fleet' of pack-donkeys would have been

appropriate adjuncts to the burial of one whose power derives from control of this facility (as perhaps with slaves interred with their masters), whether manifested as actual animals or as figurines.

EB II and III urban centers with their large populations could have had their own group of merchants as in the case of Ebla palatial economy of the third millennium BC (Pettinato 1979) or that of second millennium merchants in Ugarit (Rainey 1963). Such likely analogies suggest that the existence of a cult related to donkeys as beasts of burden was related to the existence of a group socially differentiated from the rest of the population by its economic activities, i.e. merchants and/ or donkey herders. (Milevski 2011:232)

The social differentiation indicated by donkeys in burials may therefore be horizontal rather than vertical: a specialist rather than higher-class caste, with the prestige element applying to the donkey-employer not the donkey itself. Amiran (1985:192), Milevski (2011:177/ 196/232-3) and Greenfield *et al.* (2012:43) suggest that these burials and figurines (APP II.21) might also relate to donkey breeders, traders or drivers; these groups were also likely to have been socially distinct (see Chapter IV.1), but if more recent parallels can be employed these may have consisted more of low-status castes whose close association indeed lends denigratory connotations to donkeys, who are in themselves perceived as difficult by those inexperienced in their use (Chapter III.1). Cochin (1995:62) records that in West Africa an untouchable caste breeds donkeys and suggests that strongly-hierarchical societies may classify their domestic animals into hierarchies, assigning donkeys to women and children and to low-caste groups. Today as in antiquity, practical attitudes to ownership of a useful asset go hand in hand with an extremely long tradition of pejorative attitudes to donkeys: the term 'donkey' was often an insult in ancient Egypt and Mesopotamia as now (APP II.21 and II.34), and in Egypt the donkey became associated with the god Set and with notions of evil (APP II.21); Osborn and Osbornová (1998:135) suggest that 'the donkey eventually became the 'supreme scapegoat' and that its image was destroyed in magic rituals.' Power (2004:131) notes that

[t]he donkey is perhaps one of the most important, albeit neglected and misrepresented animals in history.... this animal's relentless work and almost inexplicable endurance over possibly 6000 years of domestication is overshadowed by one of the worst reputations in the animal world... for being stubborn, unruly, and hard to control – a reputation endorsed by many of the secondary sources in the handful of references to donkeys that exist within the Egyptological literature.

She suggests (p132-4) that donkeys are ascribed low status because of their loud brays and their habit of frequent copulating and erection in public (Figure 11), recording their common depiction 'with spontaneous erections and masturbating' (p133). Marshall and Weissbrod (2009:72) suggest a very similar explanation in modern Kenya for 'the apparent and pervasive disjunction between the importance of Maasai donkeys for survival and their relatively low status':

because of their slow growth rate donkey herds are not ideal for accumulation of wealth, and donkeys are not considered to be food. Donkeys in Africa are also well known for the length of the penises, their sexual activity and, when they are not herded, for copulating in public places. Furthermore donkeys are noisy and their bray is intrusive'. (Marshall and Weissbrod 2009:72)

As discussed in Chapter VIII.1, this appears to be a factor in the contempt in which they are still held by authorities in modern developing regions.

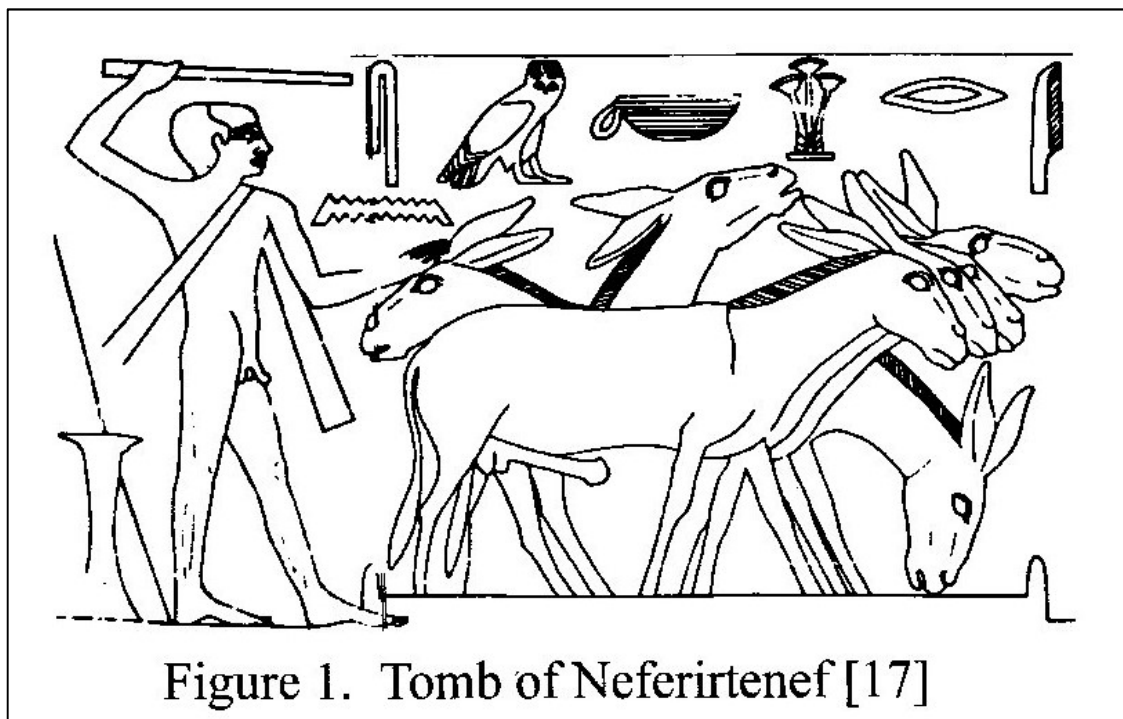
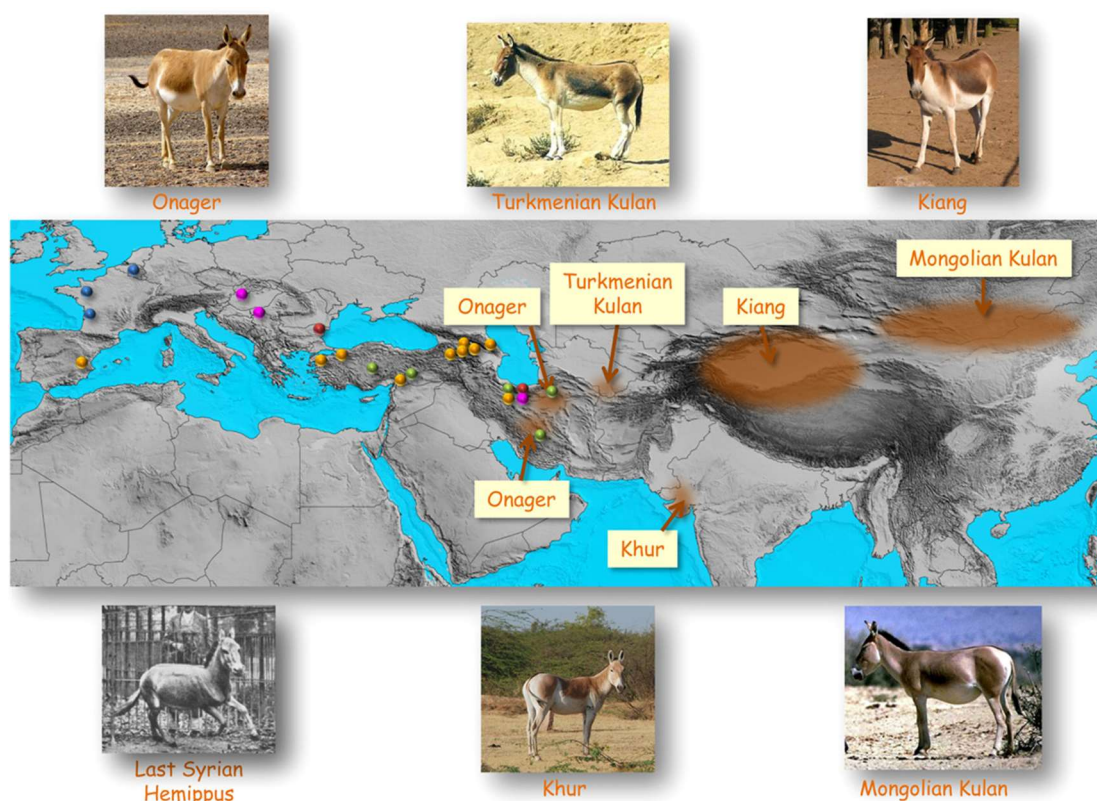


Figure 11: Misbehaving donkeys in 3<sup>rd</sup>-millennium BC Egypt (Power 2004:144, by permission)

### ***Onager-donkey hybrids, and horses***

*Equus hemionus* is similar in appearance to the wild donkey and native to the arid belt from Syria to Mongolia (APP II.43, and Figure 12), and perhaps in the southern

Levant, with its range and population size much reduced since antiquity, and its fertile interbreeding much reduced by long geographical separation of groups such as the kiang, kulan, khur and onager (Geigl and Grange 2012:89). There is debate as to the relationship in the far past between *E. hemionus* and *E. asinus* (Geigl and Grange 2012:92; and see the Glossary), but by the period under study the separation is clear. The distribution of onagers possibly overlapped with the distribution of wild donkeys, though the two were divided by their differing habitat preferences, with onagers preferring flat sandy regions and donkeys rocky hills (APP II.43).



**Figure 12:** 'Current natural distribution range of the Asiatic wild ass and geographical location of the archaeological sites that were sampled in the present study and the palaeogenetic results yielded: Upper Palaeolithic sites (blue dots), Neolithic sites (green dots); Chalcolithic sites (red dots); Bronze Age sites (orange dots); Iron Age sites (pink dots). Brown clouds indicate the areas where Asiatic wild asses naturally occur at present.' (Geigl and Grange 2012:90, by permission)

Onagers in the Ancient Near East were hunted for meat and perhaps hides from early times, for example at 8<sup>th</sup>/ 7<sup>th</sup>-millennium BC Ali Kosh and El Kowm in Iran and Syria (Hole and Flannery 1967:175, Vila 1998:144), and (especially perhaps for hides) at early 6<sup>th</sup>-millennium BC Umm Dabaghiyah in NE Iraq (Kirkbride 1974:85). There is evidence of large-scale onager-hunting in the 6<sup>th</sup> and 5<sup>th</sup> millennium BC in

Syria, Iran and the southern Levant, and they continued to be hunted in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC and later (APP II.43), and even up to modern times (Zarins 1986:179, 2014:15-16). The onager's intractable and restless temperament contrasts with that of the donkey (Davis 1980:290, Groves 1974:105), and it is now increasingly (though not universally) agreed, from faunal and textual evidence, that although onagers may be tameable as foals or temporarily held for hybridising, they were never domesticated for work (APP II.43); Zarins (2014:17-32/45-7/65-7) makes a comprehensive case for interpretations of historical accounts and earlier texts falling prey to confusion with donkeys and hybrids.

Hybridisation of the onager with the domesticated donkey is likely to have been pursued for the sake of the heterosis (hybrid vigour – good size, hardiness and ability to survive on poor food) common in crosses and demonstrated in the horse-donkey cross mule; use of native onagers also extended the stock of imported or rarely-obtained donkeys despite the disadvantage of the sterility of the offspring (Clutton-Brock 1992:42-3, Gray 1972:98, Sherratt 1983:96). Texts and representations are so far the main indicators of the emergence of onager-donkey hybrids in the early or mid 3<sup>rd</sup> millennium BC (APP II.43), but a new era has been heralded by the identification by mitochondrial DNA of the equids ceremonially buried at Umm el-Marra at the end of the 3<sup>rd</sup> millennium BC as being male onager/female donkey crosses (Champlot *et al.* 2010) and showing signs of use for work (Weber 2008:501-5). At 3<sup>rd</sup>-millennium BC Tell Brak (ancient Nagar in NE Syria), seal impressions indicating provision of hybrids to ceremonial centres are closely associated with evidence of the careful keeping of equids and of valuable objects (Oates 2001:279, Oates and Oates 2001:41-7); these indications are reinforced by accounts in 3<sup>rd</sup>-millennium BC tablets from Ebla of the flourishing hybrid-breeding centre at Nagar (Archi 1998:10, Ur 2010:409) and of Ebla's additional approaches to centres further east with requests for good hybrids. The Ebla and Diyala texts record the prices for hybrids rising sharply in the 3<sup>rd</sup> millennium BC, to six or even forty times the price of a donkey (Zarins 1978:14, 1986:185-7).

By the 2<sup>nd</sup> millennium BC the onager was replaced in Mesopotamia by the horse for hybridisation use (APP II.43); however, the horse-donkey hybrid (the mule/ hinny) is excluded from the scope of this thesis, as modern usage and management comparisons with the onager-donkey hybrids of the earlier period upon which I am focusing would be inappropriate given the genetic influence of the very different physical and behavioural characteristics of the horse. Onager-donkey hybrids are

still produced in India and Iran today but accounts of their usage are too limited for present purposes (Gray 1972:95-8, Groves 1974:163-4).

Horses are native to the central Asian steppes and were probably first domesticated there (perhaps initially for food) in the 4<sup>th</sup> or possibly 5<sup>th</sup> millennium BC; wild horses may also have been present in Anatolia and Iran, with the domestication concept filtering into these regions, or domesticated horses may have been imported and passed on into Mesopotamia and the southern Levant (APP II.43). The earliest textual and iconographic evidence of horses appears during the 3<sup>rd</sup> millennium BC, but horses are apparently rare until the early 2<sup>nd</sup> millennium BC (APP II.43).

### III COMPARISONS OF CATTLE AND DONKEYS

#### III.1 Donkey and cattle physiology and behaviour

Throughout this thesis I have discussed the adoption and use of working donkeys and cattle, and in Chapters VII.1 and 3 I outline the use of donkeys in particular for transport. The chapters below, on the comparative physiological and behavioural irreducibles of donkeys compared with cattle when used for ploughing, and more broadly for work, aims to provide a practical briefing – as noted in my research aims – as a background to interpretation of the situation in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia.

The diagram in Figure 13 below, from a treatise on harness in modern Africa, illustrates the extreme complexity of making theoretical comparisons of working animal performance, even without additional economic and cultural factors (discussed elsewhere) and issues such as availability of animals and information on their use. In practice there is a long history worldwide among farmers of pragmatic assessment of choices and trade-offs, and of empirical actions – not necessarily the theoretical best choices – taken. ‘A farmer will realise without any complex analysis whether using draught animals in a particular way (or at all) is profitable or not’ (Lawrence and Pearson (2002:103)), though ‘the economics are not always clear to the outsider’ (Starkey 1994a:75, on modern African practice).

Chapman (2003:65) notes that in Giddens’ structuration theory agents may be knowledgeable but not omniscient, while Russell (1988:7) argues that it is simplistic to assume that decisions are always led by pure cost-benefit considerations. Donkeys and cattle often have complementary roles, each being multi-purpose: donkeys for flexible use including transport (e.g. Sims and O’Neill 2003:39), cattle for later meat value and (if female) milk (see Chapter IV.2 on the limited use of donkey meat and milk). Oxen have greater absolute power (see Table 3 below), if this is needed, for heavy soils, but a higher purchase and maintenance cost, including the issue of theft due to their greater value (Chapter IV.2). Donkeys are strong for their feed input (Table 3), low-maintenance (APP II.14 and Chapter VI.1) and have a longer working life (APP II.17); they are easy to train and handle and require little supervision (see below). ‘Farmers prefer the strength of large oxen, but value the lower risk of small donkeys’ (Starkey 2011:25). As expanded upon in Chapters VIII.1 and 4, in modern Africa there are cultural prejudices in favour of

cattle as they are considered higher-status, but donkeys are widely used by women who otherwise are not permitted access to working animals.

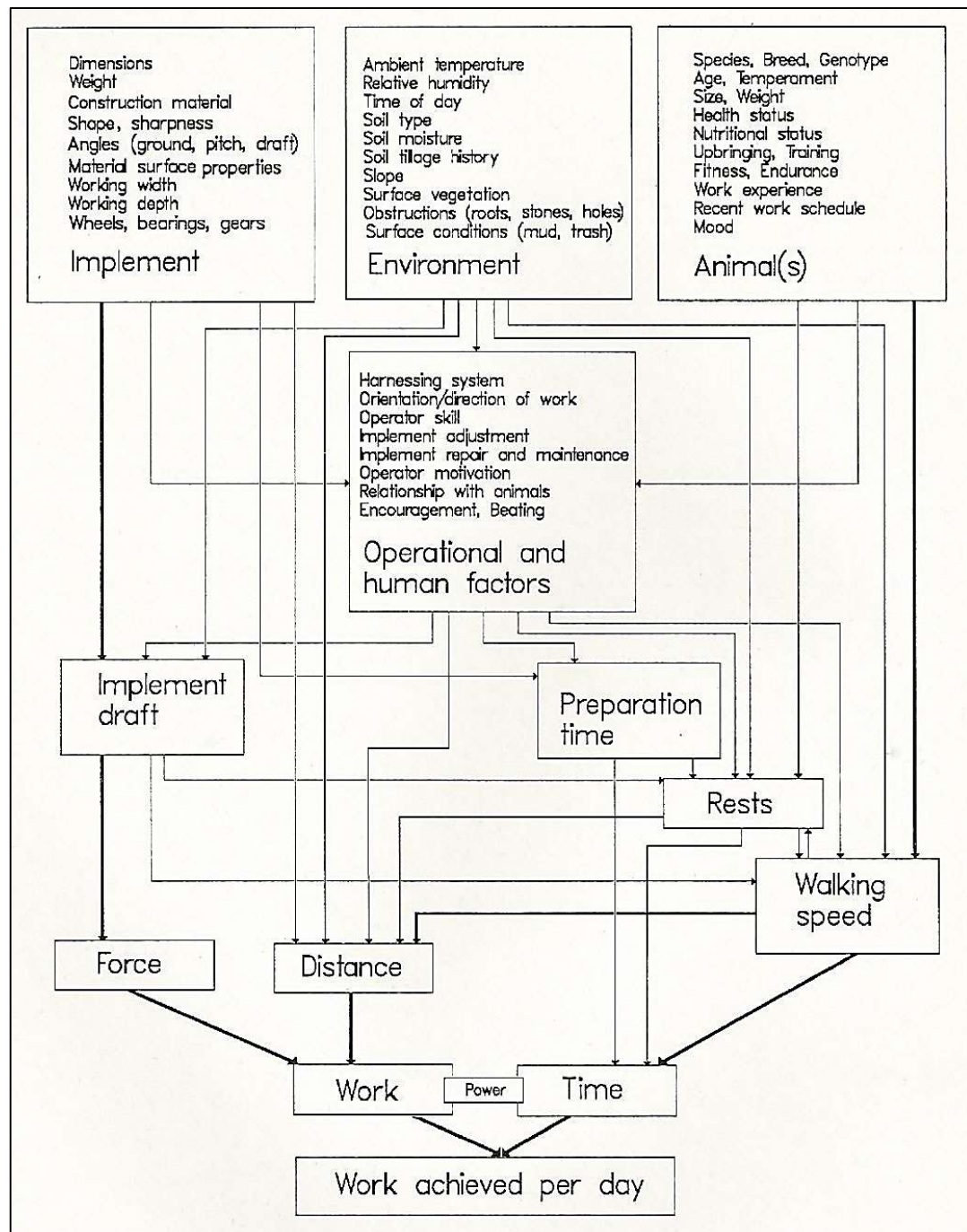


Figure 13: Diagram showing some influencing factors on daily work output for ploughing animals (Starkey 1989:20, by permission)



## **Physiology**

As noted in Chapter IV.2 below, oxen have powerful shoulders but a relatively weak chest (APP II.6), and a yoke is designed to be powered by the shoulders, with the yoke held forward by the ox's strong withers (Litttauwer [1968] 2002:483). Donkeys have low, bony withers, with an equid's long slender thin-skinned neck and muscular concentration in the chest (APP II.6); early depictions of state-controlled animal ploughing in Mesopotamia indicate that it was normally carried out with a pair of animals and a yoke, which militated against donkey use as the yoke is not suited to their body shape and restricts the power that they can deliver (APP II.6, and see Chapter IV.2).

Paired oxen are hard to turn (Blench 1997:13) as they are bulky and have relatively inflexible necks, as well as having insensitive hides (Viebig 1982:145) and so may not move their head away from the touch of a whip (Barker 1964:161); ploughing oxen generally therefore need to be led round turns, and the turning circles need to be large – though there is evidence that the few seconds of rest resulting for the ox can benefit its continuing performance (Renger 1990:272, Starkey 1989:167); the benefit of this fleeting rest-moment has also been noted in the case of Nepali porters (Malville 1999:8-10, 2001:234-5, Malville *et al.* 2001:44). Makwanda *et al.* (2000:175) describe how in Tanzania the weeding pattern for a pair of oxen involves moving across the field and back in alternate blocks of five rows, thus avoiding sharp turns at the headlands. In contrast, donkeys have a flexible neck designed for browsing and for watching for dangers while feeding (APP II.9); this, and their narrow bodies, allows them to turn sharply (e.g. Mpande 1994:152, Sosovele 1997:109). Hagmann and Prasad (1995:235) add that oxen, being bigger, damage crops more than donkeys during weeding, and unlike donkeys do not naturally tend to walk in straight lines; so donkeys are preferable for pulling precision instruments such as seeders (Starkey 1987:39).

Ploughing practices, and the animals used, can provide detectable field configurations; squareish fields are preferred for cross-ploughing (Brigden 1984:8) but long runs for single furrowing and even S-shaped fields to facilitate turning of large, cumbersome teams and ploughs, as developed in Mediaeval Europe (Brigden 1984:8, Molnárová 2008:27-8/32). In the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC in southern Mesopotamia, centrally-organised irrigation systems resulted in long, narrow fields – well-suited to ploughing with animal teams – between furrows channelling water

from canals (Liverani 2006:16-17, Widell 2013:58). Heimpel (1995:93) has analysed late 3<sup>rd</sup>-millennium BC texts from Girsu with the aim of correlating use of ploughing donkeys with the number of furrows seeded in different areas, though with no specific conclusions.

Donkeys in the wild are capable of running at 40-50km/hour, for example during breeding behaviour or dealing with predators (Maekawa 1979b:48, Shackelford *et al.* 2013:4172-7), and have a lower-leg conformation which resists shock when moving at speed; they have much better acceleration than cattle (see below), though they have a jolting gait at speed, reducing their desirability as a riding animal (APP II.9 lists commentators supplying information on all these points). Donkeys have a uniquely-efficient ankle construction which allows very high energy transfer in motion, well beyond that of cattle and humans, and a gait that minimises energy-consuming vertical oscillation, especially in rough terrain (APP II.9). Dijkman (1992:155) also suggests that 'non-muscular structural elements' in the donkey's anatomy (a feature also noted in African women headloading) may contribute to its notable ability to carry heavy loads. Donkeys' capacity for weight-carrying is affected by the position of the load on their back and by any harness and padding (APP II.9). The donkey's energy cost of standing is somewhat higher than cattle but the energy cost of walking is only half that for cattle, and that for pulling also less (Jones 2008a:12, Tisserand and Pearson 2003:64)

These energy-saving adaptations, which enhanced survival in desert conditions, increase the donkey's suitability as a work animal in hot climates with limited food and water supply (APP II.9). Donkeys are widely evidenced as being able to go without water for up to three days (APP II.3); they can withstand up to 30% body-weight loss by dehydration, and can then rapidly take up a full day's-worth of water (up to 25-30 litres in a few minutes; Förster *et al.* 2013:195, Yilmaz 2012:71). Dehydration at high temperatures reduces donkeys' food intake but 'apparently increases digestibility of ingested dry matter' (Förster *et al.* 2013:195). The different grazing and foddering needs of cattle and donkeys, and their effect on comparative performance, are discussed in detail in Chapter VI.1.

Cattle can be unstable on slopes and stony areas but come into their own on heavy, boggy ground, while donkeys are at home on rough, rocky ground and have good balance on slopes (APP II.9). The position of donkeys' eyes allows them to see all four feet at once, making them very footsure (Yilmaz 2012:23). Donkeys have

narrow, hard hooves suited to their native arid, stony desert conditions (APP II.21), in contrast for example to those of horses from the grassy steppe (APP II.9). As described in the paragraphs below on behaviour, donkeys use their sharp hooves to attack predators and to dig for water (APP II.9). Donkeys' hooves can nevertheless become soft and overgrown if not used regularly on hard ground, or if donkeys are kept in damp regions (APP II.9). Both donkeys and oxen are susceptible to the hoof-damaging condition of laminitis; and in both, heavy work affects the hoof core, as noted in faunal remains such as in the donkey skeletons found at 3<sup>rd</sup>-millennium BC Tell Brak in northern Mesopotamia (Clutton-Brock 2003:126). Cattle are considerably more prone than donkeys to suffering incapacitating foot damage, particularly in drier regions and on hard or stony surfaces (APP II.9), and there are accounts going back to antiquity of concern for their feet. Old Babylonian laws and contracts mention penalties for damage to ox hooves (Roth 1980:129/132/135), and wrappings for damaged ox hooves are mentioned from Roman times to the present (e.g. Clutton-Brock 2003:126).

### ***Zebu versus taurine cattle***

It should be borne in mind that modern African data on cattle physiology and behaviour often relates to animals with at least some zebu blood (see APP II.8 for commentators on *Bos taurus* versus *Bos indicus*), and care is necessary when drawing inferences about cattle performance in the Ancient Near East before the later advent of the zebu strain. Early domesticated cattle in Africa were taurines, as in the Ancient Near East and Europe, but from the 1<sup>st</sup> millennium AD these were increasingly hybridised with zebu (*Bos indicus*) stock from Asia via Arabia (e.g. Clutton-Brock 2012:110). Zebu have various physiological advantages over taurines in hot, dry environments, and better resistance to many diseases, and are favoured as they are larger than African taurines such as N'dama; however, the latter are fully heat-adapted and have more resistance to tsetse-fly-borne trypanosomiasis and so are preferred in some African regions.

Until the 4<sup>th</sup> millennium BC only *Bos taurus* was known in Mesopotamia (Epstein and Mason 1984:14), though this does not rule out comparison with sub-Saharan African cattle: Galvin (1987:123-6) notes that 100% *Bos taurus* animals in modern Syria are fully heat-adapted, with convergence of characteristics with the zebu, and that 'genetic changes reflecting product specialization in bovids... had taken place

by at least 3000BC' (Galvin 1987:123) in Mesopotamia. Meanwhile, *Bos indicus* may have arrived at the eastern margins in the early 3<sup>rd</sup> millennium BC, and in southern Mesopotamia by the mid 3<sup>rd</sup> millennium BC, probably via the Gulf (Arbuckle 2012a:215), though so far the evidence is solely from depictions rather than faunal evidence (Matthews 2002:442-4).

### ***Energy and work rates***

A theme of this part of my thesis is that assessment of the relative benefits of using donkeys versus cattle in a farm environment is vital but extremely complex. Many published calculations, for example of hectares cultivated per day, ignore a wide range of social and practical factors, as set out in this chapter and elsewhere; but in practice, as is demonstrated daily in ancient and modern farm-based circumstances, farmers make rule-of-thumb decisions about the most suitable animal type and system to employ.

Calculating the comparative practical performance of working animals includes assessment of speed, force/ output related to input in terms of investment, hours worked daily and coverage of the ground; this is influenced by particular empirical needs for the task in hand, such as a sustained hard pull, long hours, high speed, etc. Figures for these are significantly affected by local conditions and by the condition of the animals; for example, at the start of the working season animals may take a few days to reach top performance, and individual animals may peak rapidly or maintain an unchanged work rate (e.g. Pearson and Vall 1998:315, Starkey 1989:163). Smith (1991:211) reports that well-fed, well-maintained animals can apply 20 percent more energy to a task than animals poorly fed and maintained. Other factors can include the skill of the farmer, the training and condition of the animals, terrain, and rest periods (e.g. Löwe 1986:20, Renger 1990:269); Renger (p275) concludes that in antiquity as now 'the human factor is decisive for increasing the effectiveness of animal power' in quality of 'training, guidance, feeding and care'. Nevertheless, an attempt is made in Table 3 below to provide comparative performance estimates and averages for ploughing donkeys and oxen from ethnographic and other information.

Table 3: Energy and work-rate findings for donkeys and cattle

Speed
<ul style="list-style-type: none"> <li>• Ploughing speed (very contingent on local factors): oxen 2.3-2.5 km/ hour, donkeys 2 km/ hour (APP II.28)</li> <li>• Balance to be struck between average speed, power output and number of hours of work (not a simple calculation although rules of thumb are habitually applied by users):  <p style="margin-left: 40px;">Equids are more suited to rapid low draught activities where their faster speed can be used to advantage. At higher draught forces, where speed is less important, the additional weight and power of cattle are an advantage (Pearson and Vall 1998:309)</p> </li> <li>• Confusion in comparative accounts because donkeys and female cows generally plough more slowly than oxen but are faster for lighter work such as seeding and weeding (APP II.28), and for transporting items to and from the fields; donkeys walk at circa 4-5 km/hour (APP II.28)</li> <li>• Oxen work slowly, at a single speed, but have greater endurance in heavy traction; donkeys have a wider range of speed, and better acceleration (APP II.28)</li> <li>• The extent of rest periods, for the animals and the ploughing individuals, is a factor (Nengomasha <i>et al.</i> 2000:24, Renger 1990:269, Starkey 1989:167, and see APP II.3)</li> <li>• In ploughing a key factor is the time that it takes to turn the animals (see above)</li> <li>• Speed also decreases if the number of animals in a team is increased (APP II.28): a trade-off is made between power and speed, and the oxen may be able to work for a little longer as they are working less hard (Renger 1990:271)</li> </ul>
Force/ output
<ul style="list-style-type: none"> <li>• Oxen are stronger for ploughing than donkeys in absolute terms (APP II.13), due to their extra weight. A typical African ploughing donkey weighs 125-150kg (APP II.28), and probably no less in antiquity (see Chapter IV.1 on donkey sizes), and an ox 300-500kg, though oxen in ancient Mesopotamia are estimated to have weighed as little as 200kg (Renger 1990:269)</li> <li>• Absolute weight can be better for tasks such as threshing</li> <li>• However, the extra strength is not necessarily required: farmers may shallow-plough, and the soil may be light and sandy (APP II.31), and not benefited by deep ploughing. Potts (1997:73-5) notes that the 2<sup>nd</sup>-millennium BC Sumerian text <i>Farmer's Instructions</i> (Black <i>et al.</i> 1998-2006d) recommends ploughing but is referring to a light ard, which would stir the earth to protect moisture but not dry out the ground as with a mouldboard plough (Chapter V.1)</li> <li>• Energy-rating studies conclude that donkeys can pull a larger percentage of liveweight than oxen (APP II.13). Oxen are generally considered to be able to pull 10-12% of their body-weight depending on breed and other factors such as harness and terrain; figures for donkey traction are rarer, but Prasad <i>et al.</i> (1991:237) cite an FAO study stating that donkeys can pull 16-20% of their</li> </ul>

<p>body-weight; Starkey (1997:193) suggests a figure of 12-25% of liveweight and up to 40% for short periods</p> <ul style="list-style-type: none"> <li>• Significant constricting effect on donkey output if the animals are unsuitably harnessed with a yoke (see above)</li> <li>• For draught force and output factors see APP II.13</li> </ul>
<b>Hours worked</b>
<ul style="list-style-type: none"> <li>• Oxen can typically plough for 4-5 hours/ day, donkeys for 3-4 hours/ day (APP II.13; but see caveats)</li> <li>• Body condition can affect duration of work (e.g. Bartholomew <i>et al.</i> 1994:63)</li> <li>• The Prasad <i>et al.</i> (1991:236) study cited above asserts that donkeys can only work for two hours before becoming exhausted, but as discussed this relates to unsuitably-harnessed animals. The authors themselves agree that it is very likely that use of a breastband would have increased the donkey hours worked, perhaps to equal those of cattle (Hagmann and Prasad 1995:237, Prasad <i>et al.</i> 1991:237)</li> <li>• Unlike cattle, donkeys do not require a rest period during the day for rumination (APP II.3); they graze more slowly than cattle, but graze at night (APP II.14)</li> <li>• Oxen may set their own working limit, refusing to work harder, or may lie down and refuse to move, while donkeys can be induced to carry on working when exhausted (Lindblom 1931:22, Starkey 1989:164)</li> </ul>
<b>Ground coverage</b>
<ul style="list-style-type: none"> <li>• Accounts of ploughing with a pair of oxen and a simple plough indicate a normal coverage of c.0.2-0.4 hectares/ day (APP II.13)</li> <li>• Donkeys will cover less hectareage not only due to lower speed and possible earlier tiring, but because they can turn more sharply and so plough more furrows per hectare (Hagmann and Prasad 1995:237)</li> <li>• Animal-powered weeding can cover perhaps 50-100% more land than ploughing (Mongomongo and Gembe 2000:185)</li> </ul>

### **Care and disease**

In the dry climate of modern Iraq, endemic diseases affecting donkeys are not a significant issue aside from parasitic infestation and infected harness-sores (Jaafar Jotheri pers. comm. 2014). In modern Lebanon, apart from some cases of glanders, donkeys mainly die of old age or accidents (Nasser Kalawoun pers. comm. 2017). Donkeys are well-known in modern Africa for being more resistant than cattle to and tolerant of a range of animal diseases, and for being able to cope better with parasite loads than many other domesticated animals (APP II.3); while parasites are commonly noted as a cause of death, this is likely to be through their low incidence of death from other causes. A modern issue not addressed in this thesis is the major effect on use of working animals in humid regions of Africa, particularly cattle, of

trypanosomiasis, carried by tsetse flies. Taurine cattle (the species present in 4<sup>th</sup>-3<sup>rd</sup>-millennium BC Mesopotamia) are mainly very susceptible, zebu cattle less so; donkeys are more resistant than cattle (Mpande 1994:153) but do succumb (de Wilde 1967:106, Mitchell 2017:30/34). Starkey (2011:25) notes that in modern Africa '[f]armers are often aware of the health problems and short life expectancy of donkeys in more humid areas, but they may still take risks because of the large benefits that the donkeys could bring if they were to survive.'

Donkeys are also subject to colic if they are fed wheat grain or other rich food (Borwick 1981:121), and to harness sores and other work injuries due to their comparatively thin skin (APP II:6). As noted above, in Iraq today infection of harness sores is a common cause of donkey mortality; as described in Chapter IV.2, in antiquity and today unsuitable harness is used for donkeys in particular. Cattle have thicker hides, but Girsu texts from the 3<sup>rd</sup> millennium BC nevertheless attest to measures to prevent sores such as pieces of cloth put under the yoke (Renger 1990:273). Unlike horses, donkeys do not benefit from grooming: the dust content in their coats protects them from insects and heat (APP II.9).

Donkeys breed more slowly than cattle but can have significantly longer lifespans (see Chapter IV.1). A number of commentators on the physiology and behaviour of donkeys make use of the term 'hardy' (APP II.9), denoting sturdiness and the ability to endure fatigue and difficult conditions over long periods. Descriptions of the utilisation of donkeys in the present and past, particularly for pack in desert environments, underline this trait, with donkeys commonly operating 'at the boundaries of their physiological abilities' (Shackelford *et al.* 2013:4177), well beyond those of other working animals until the advent of the camel. Ruthenberg (1983:326) points out the importance to nomadic breeders of camels over all other features of breeding of 'a high level of resistance to trekking, drought, heat, cold, disease, and periodic shortages of food', as a specific economically-valuable advantage, with other features mentioned in breeding (colour, height, conformation) possibly consequent.

### ***Behaviour***

Donkey behaviour patterns are often misunderstood as they are thought of as 'small horses' (Hart 2012, McGreevy 2004:30). This is erroneous as the two species have

major behavioural differences in the wild, arising from their different habitats, which are reflected in their differing responses to situations in a domesticated environment. Horses originate in the cool grassy steppe and donkeys in hot, arid North Africa. In arid regions, where food and water are scarce, a loose social structure allows individuals to roam long distances daily, keeping the density of animals down while allowing some social linking for protection (French 1997:125-7, McGreevy 2004:139); donkeys' loud bray, audible over several kilometres, enables them to remain in touch across sparsely-populated areas (McGreevy 2004:162). Donkeys are described by some as herd animals (e.g. Littauer and Crouwel 1979:28), but a better term is sociable: in the wild they form shifting associations with a small number of other individuals (APP II.26); therefore while they actively enjoy company, of their own or another species, and readily team up with other donkeys or humans (APP II.26), unlike oxen they also work well alone.

Donkeys have developed highly flexible patterns of behaviour and social organisation. It is this very flexibility that has enabled donkeys to survive and thrive in many different situations. (French 1997:136)

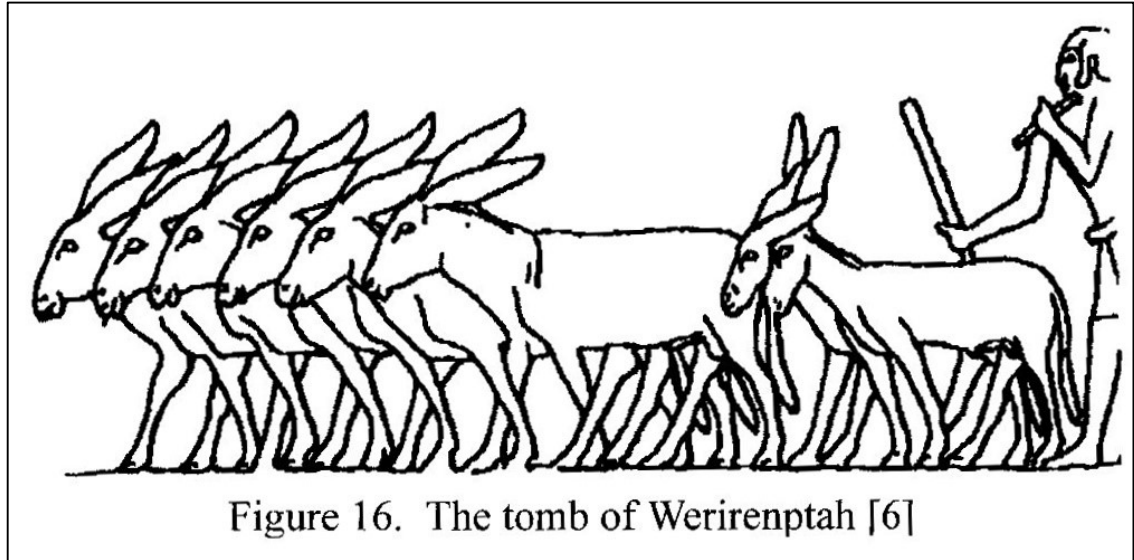
Almost all working animals are of species that naturally form groups, and their relationship with humans seems to involve regarding humans as members of their group, usually in the capacity of leader, or at any rate guardian. (Jones 2008a:5)

In small groups as opposed to herds, signs of stress or pain are seen as indicative of dangerous weakness and the animal is excluded from the group, or if defending a territory is targeted for attack; in contrast in herds, reactions to threats alert the whole group so are seen as advantageous (Hart 2012). The small-group characteristic translates into the well-known patience and stoicism of donkeys, as they are behaviourally adapted to showing few signs of pain (APP II.26).

Unlike full herd animals, which have a strategy of fleeing from a threat (as predators should only catch the hindmost), donkeys become immobile or group and face a predator, as a good strategy in a small group under threat. They have a natural highly-developed sense of individual self-preservation, and their strategy is to 'freeze' and assess situations and obstacles cautiously before making a move, whether in dealing with a predator or if they do not understand what they are being asked to do or why (APP II.26). This can be misunderstood in working situations as uncooperativeness or stupidity, and in the Western world and elsewhere donkeys are famously considered to be stubborn and difficult. Power (2004:131-6) also



reports the dichotomy of view in 3<sup>rd</sup>-millennium BC Egypt, where donkeys are described in the (urban) texts as difficult (Chapter II.2) while the depictions in tombs commonly show them as cooperative (Figure 14).



*Figure 14: Cooperative donkeys in 3<sup>rd</sup>-millennium BC Egypt (Power 2004:147, by permission)*

In studies of modern use in Africa and Asia, donkeys are widely agreed to be less demanding than oxen to control; they are not generally aggressive to humans and can be handled, harnessed and worked by a single individual, including women and children (APP II.2). As described in Chapter IV.2 in relation to harness, early 3<sup>rd</sup>-millennium BC depictions of equids sometimes show them muzzled (Littauer and Crouwel 1979:30), but probably to stop bickering between males, or because they were difficult hybrid animals. Donkeys are also widely acknowledged to be quick to learn from other donkeys and from humans, to remember their training longer than cattle (e.g. Kjaerby 1983:159) and to carry out tasks with minimal or no supervision (APP II.2).

Donkeys have a good memory for routes (APP II.2): in the wild they range long distances in search of preferred food and can find their way back to their home territory (Jones [P.A.] 2009:3, Jones 2008b:49-50, Förster *et al.* 2013:195), and owners often make use of domesticated donkeys' ability to return home alone (APP II.2). Starkey (1995:148) reports on donkeys sent unaccompanied daily down the hill from a village in Latin America where they are loaded with water and return solo, and there are accounts in Africa and elsewhere of donkeys regularly sent

unaccompanied across national borders laden with smuggled goods (Chapter VII.3), an employment hardly possible for cattle.

This and their propensity to follow a leader allows large groups of donkeys to be controlled by one person on regular routes (Starkey 1995:148). Donkeys in the wild naturally follow a leader in single file (Hagmann and Prasad 1995:235, Jones 2008b:49, Jones 2000a:190), so easily learn to walk in straight lines and recognise furrows (APP II.2). Patrick *et al.* (2000:258) note that in Botswana 'jobs which require careful and more accurate implementation such as row planting' are found to be better done by donkeys than cattle as the former are 'less hasty'. Kerman (1985:17) reports from work in tropical Africa that a number of farmers consider that oxen lack 'un sens du travail dans les champs' [an understanding of the work in the fields].

Separately, donkeys' instinct to stand and face predators has led to them gaining popularity as guard animals for cattle, sheep and goats in the USA, Canada, Australia, South Africa and elsewhere, and it is estimated that 25,000 guard-donkeys exist worldwide. A guard donkey is trained by accustoming it to the flock, and it can guard up to 400 sheep, goats or cattle; this role combines donkeys' sociable propensities with their aggressiveness towards predators: with their sharp hooves and strong teeth (APP II.9), donkeys attack and sometimes kill coyotes, jackals, wild dogs and other predators (APP II.26, and Figure 15).



*Figure 15: Donkey killing a coyote in the USA (Steve Hipps/ Georgia Outdoor News 2014)*

### III.2 The poor man's ox: cows for ploughing

While the importance of male cattle for work in antiquity and today is undisputed, very little attention is given archaeologically to the additional possibility of working female cows – the 'poor man's ox'. Sherratt (2006:336) refers briefly to the unsuitability of cows for heavy pulling in Neolithic Europe; but cows have been used up until recent times, and most of the cattle still working in Europe today are cows (Starkey 2011:25); as an example,

[c]ows were extensively used for draught in Germany during the 1930s and 40s without significantly affecting fertility and milk production because draught cows were given an extra feed allowance. (Jabbar 1993:265).

Cows are very widely used for work in Asia (APP II.4), with a large proportion of draught animals in Indonesia and Bangladesh in particular being female. Minghao Lin (pers. comm. October 2015) notes that in north China in the 2<sup>nd</sup> millennium BC cows were favoured for ploughing, and suggests that this was because bulls were often required for sacrifice. An intriguing contrast lies in the widespread use of cows for work in Asian Muslim cultures (far more so than in Hindu areas) and in North Africa (Starkey 2011:32) and the reluctance to use cows for work in Muslim areas in sub-Saharan Africa such as in the northern regions of Nigeria and Ghana (Bobobee 1999:61, Abubakar Suleiman pers. comm. 2013). Cows are the main ploughing animal in Egypt, and in other African regions working cows are common and increasing; APP II.4 lists a range of authorities on modern and ancient use of cows for work and the implications of this.

Cows are not necessarily less strong weight for weight than oxen, and are said to be easier to train (Matthewman 1987:219, Reh 1982:80), but are generally smaller and need to rest more often (APP II.4); however, the extra power of oxen is not always needed. Views vary on whether cows (and uncastrated bulls) live and work longer than oxen; Halstead (2014:16) reports that in recent Greece working cows became worn out at an earlier age than oxen, while others note that working cows live to perhaps 15 years or more (Epstein and Mason 1984:7, Isager and Skydsgaard 1992:89). The difference may lie in the greater focus on the meat value of oxen: Reh (1982:80) reports that in Africa

cows can be used for draught work over a lengthy period, thereby reducing the need to train animals so frequently (7-9 years in comparison with 2-5 years, particularly if the draught oxen are still to achieve a good meat value).

Commentators' views vary on the extent to which moderate working can affect a cow's ability to produce calves and milk; some experiments indicate that with sufficient extra feed – more than for an ox – the net benefit of combined work, calves and milk is greater than that of using an ox (APP II.4). The regime for working cows, including their unavailability for work before and after calving, does require additional planning (APP II.4), but unlike donkeys' seasonal oestrus cows come regularly into oestrus year-round.

Use of cows is often associated with small farming units (APP II.4), particularly as if a single bovine is owned it will invariably be female. Kramarik (1975:132-3) demonstrates how the development in 18<sup>th</sup>-century AD Bohemia of harness suitable for single animals (unlike the traditional yoke) allowed small-scale farmers owning a single cow to utilise it for traction, helping to reduce the inequality that may have developed with early animal traction between those able and unable to invest in specialist draught animals (Isaakidou 2008:107), and reducing required herd size (Dijkman *et al.* 2000:137, Simalenga and Pearson 2003:2). There are advantages in putting male cattle to work to bulk them up for meat (see Chapter IV.2), but use of cows allows concentration on fattening the males and selling or slaughtering at the optimum stage, adding flexibility to herd and financial management (APP II.4). In present-day Jordan, use of cows for work has been increasing as farming units become too small to justify investment in oxen (Palmer 1998:139), and in Africa the many official programmes to promote ox traction are sometimes sidestepped by small-scale farmers preferring the lower-key option of employing cows (APP II.4) – or donkeys, as described in Chapter V.4. There are indications too from African experiences that women find cows more acceptable than oxen to use for work (e.g. Muma 1995:44), making cows an attractive choice for a small farming household. The close monitoring and stall-feeding of animals on an intensive smallholding would indeed provide the high level of feeding and care needed to allow a working cow to maintain milk and reproduction levels (APP II.4).

Archaeologically, evidence of the use of working cows might therefore indicate the presence of advanced agriculture on small independent farms; Starkey (2000a:479) suggests that this may have occurred early on in Egypt, where illustrations indicate use of cows from the 3<sup>rd</sup> millennium BC (Johannsen 2011:14). In Neolithic Crete, mainland Greece and Germany, evidence of traction pathologies in cows but not male cattle may indicate small-scale cultivation (Isaakidou 2008:107, Halstead and Isaakidou 2011:66), with Isaakidou (2008:109) even suggesting a model where the

adoption of cows for work preceded that of male cattle. The evidence over time of adoption of cows for work, if modern parallels with Africa can be used, may also be an indicator of agricultural change of various kinds. If farmers are short of working animals due to disease, drought or increased demand for crops, use of working cows may increase (APP II.4). Alternatively, farmers may put their cows to work if there is a shortage of investment capital, grazing land or fodder and they wish to minimise their overall animal holding (APP II.4): use of an ox tends to be seasonal whereas a cow earns its keep year-long (Cole and Steinbach 1999:216).

So reduction in herd size may – confusingly for archaeologists – be a cause or an effect of using working cows. There are of course arguments for large herds unrelated to work needs, if the investment capital is available (e.g. Dijkman *et al.* 2000:137); reducing herd size by removing males and relying on working cows does expose the farmer to simultaneous loss on several fronts if a cow is ill, dies or is stolen (Dijkman *et al.* 2000:137, Simalenga and Pearson 2003:2).

As with donkeys, this concentration of working cow use among small-scale farmers may have largely shielded it from historical recording; Johannsen (2011:14) suggests that

[t]he use of the stronger oxen may have been the practice that was regarded most highly and therefore the one given most attention in writing and iconography.

The 3<sup>rd</sup>-millennium BC Ebla texts (Pettinato 1991:94) refer only to male cattle for work, indicating perhaps that in centrally-controlled agriculture, with large numbers of male cattle available, the extra feeding and care needed if cows are to work as well as provide milk and calves was not considered worthwhile. Cows are mentioned in late 3<sup>rd</sup>-millennium BC Girsu texts as commanding a high price (Heimpel 1995:89), and in early 2<sup>nd</sup>-millennium BC Old Babylonian accounts as working at ploughing and threshing (Stol 1995:176/185/188-91).

The presence of castrated male cattle has been a traditional archaeological indicator of working animals (see Chapter IV.2), which has contributed to the relative invisibility of working cows to date (Piggott 1983:35). The growing zooarchaeological evidence of working cows – whether for sledges or ploughing – underlines the need for a reassessment of models for use of working cattle in antiquity, as voiced by Johannsen (2005:47):

it is necessary to consider the variability of modern and historically known draught cattle husbandry strategies when studying the prehistoric use of draught cattle, and especially when evaluating mortality patterns.

### III.3 Use of female donkeys for work

Late 3<sup>rd</sup>-millennium BC texts from Sumer record that female donkeys were mainly employed for ploughing and males more for drawing vehicles (Maekawa 1979a:102/111); this may reflect the greater strength or prestige of males, or the desire to keep males and females apart to avoid bickering among the males in the presence of females or to prevent breeding: Maekawa suggests that some form of spaying or breeding control may have been exercised on some females. In modern India, carting is similarly assigned to males, and pack to females (Singh *et al.* 2007:1018). In texts on the early 2<sup>nd</sup>-millennium BC Kaneš pack caravan trade there is only rare mention of females (Dercksen 2004:259-60), perhaps because females are occupied in reproduction, as at 3<sup>rd</sup>-millennium BC Mari where texts from a breeding/ supply centre conversely refer mainly to females (Sallaberger 2014:341/347). In modern times preference for male donkeys for work has an influence on the concentration of donkey-breeding in certain areas as females are therefore not supplied to areas of donkey demand (JG Ethiopia 2014, Mutemi 2008:69).

While male donkeys may display aggressiveness if competing for females (APP II.39), or attempt to mate, experience in donkey-using regions worldwide demonstrates overwhelmingly that mixed groups of male/ female donkeys generally operate without trouble. There is some prejudice about the comparative work output of males and females (APP II.39), but others confirm that performance is similar, allowing for size (Jones 1997:70). Some reduction in work output occurs in pregnant females, but they can work until an advanced stage (APP II.39); Waithanji (2009:34) reports from a survey in Kenya that '[t]he few owners that preferred female donkeys claimed that the foal that the female produces every so often is much more valuable than the shortfalls in work output associated with the reproductive cycle'. In many donkey-using regions females are widely employed, with little differentiation in choice unless the owner is planning to breed; however, there are significant cultural variations, as exemplified by Blench *et al.* (2004:213) who report on female donkeys used in one district of northern Nigeria but not in a neighbouring one.



## IV PRACTICAL IMPLICATIONS OF WORKING ANIMAL ADOPTION

### IV.1 Breeding and supply of working animals

#### *Breeding and supply of donkeys*

##### Low-management breeding

The keeping of equids for breeding does not necessarily require intensive work: over thousands of years groups of free-roaming horses have been used in Europe, as well as more recently in North and South America, Central Asia and Australia, as providers of healthy foals at minimal care cost (Sundkvist 2004, Zimmermann 1999:309) and at even less archaeological visibility. The breeding of donkeys differs essentially from that of meat animals in its aims and process, not least because domesticated meat species are generally herd animals: donkeys are sociable in the wild, but congregate in small, shifting groups rather than herds (APP II.26).

Reproduction in donkeys is slow: female donkeys may not foal until the age of 4 or 5 in hot climates (Marshall and Weissbrod 2009:73, Mohammed 1991:185), and typically only produce a foal every other year, partly because oestrus tends to be seasonal and because females do not 'show' during oestrus so may miss mating (APP II.17), especially in the low-management systems typical for donkeys.

Pearson *et al.* (2001:50) also mention, from a survey in Ethiopia, issues of abortion, poor condition, and lack of a male for mating. Mixed groups of working donkeys from different locations graze communally (see Chapter VI.1), leading to unselective breeding. Up to modern times mobile groups in northern Africa have also caught and tamed wild donkeys for transport (APP II.14), and actively encouraged impregnation of females by local wild stallions (APP II.21), to provide renewed genetic vigour and the continued ability to endure disease and poor feed.

Shackelford *et al.* (2013:4171) add that

[t]he deep roots of this tradition are further illustrated by the first century CE agronomist Columella, who discussed the benefits of backcrossing female donkeys with male wild asses in his treatise *De re rustica* (6, 37, 3e 7; English translation 1745: 298e301). Together these factors point to relatively low levels of selection and contextualize the lack of consistent size decreases in early domestic donkeys.

The recent unlocking of the mitochondrial DNA of modern domesticated and wild donkeys (APP II.21) gives clear evidence of long-term gene flow between the two;

this evidence has advanced the debate on original domestication location and timing, indicating more than one independent domestication episode, but can also support the hypothesis – abundantly demonstrated in modern and historical times – of deliberately permeable boundaries between wild and domesticated donkey populations on a day-to-day basis (Larson and Fuller 2014:118).

The zooarchaeological, ethnographic and genetic evidence indicate strongly that aside from specialist centres (see below) donkeys have never been widely subject to strategic breeding (APP II.21) – though the culling/ castrating/ selling of males (to remove poor specimens or achieve profit) will have had some effect. Any reproductive isolation of non-specialist donkeys in antiquity is likely to have occurred in urban settings of donkey use, for example in late Predynastic and Dynastic Egyptian towns (Marshall and Weissbrod 2011:S407), or in the very controlled environment of 3<sup>rd</sup>-millennium BC Mesopotamian agriculture, at which period there is evidence on equid figurines of features such as genital strapping to prevent breeding, and of oestrus, indicating interest in guiding the breeding process (Zarins 2014:93/136-7, and Hauser [2007] 2008:469 in Figure 16).

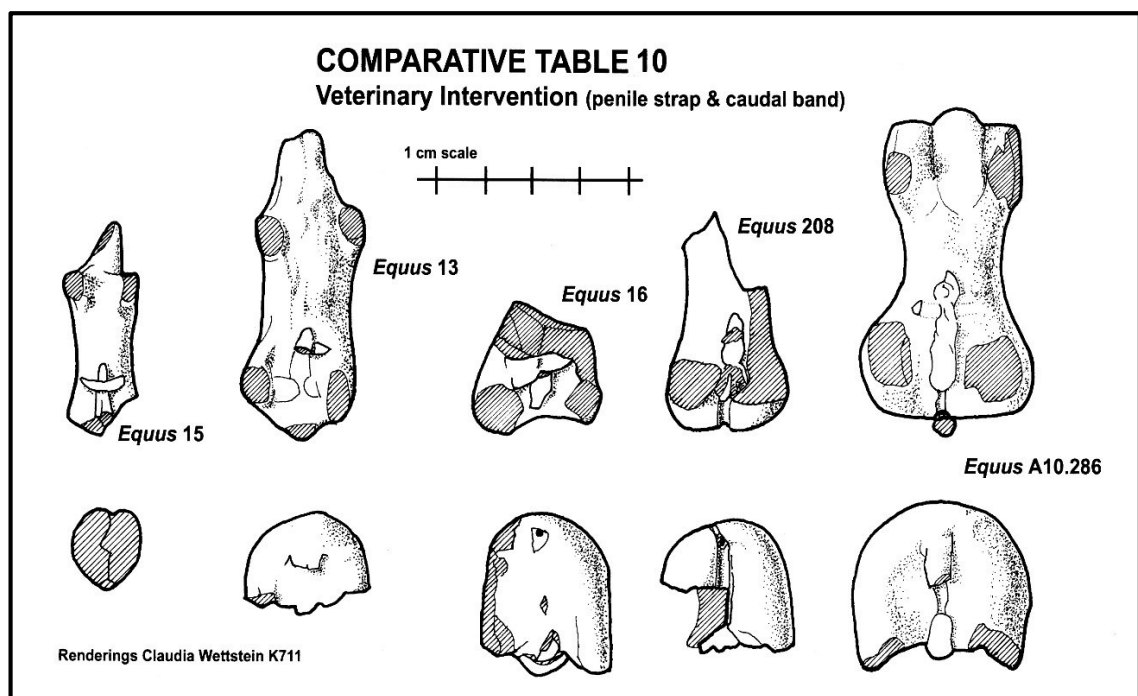


Figure 16: 3<sup>rd</sup>-millennium BC possible Mesopotamian equid figurines showing penile straps and caudal bands (Hauser [2007] 2008:469, Table 10, by permission)

### Breeding in regions

There are accounts throughout history of some regions known for their suitability for breeding particular animals. Animals have natural ecological niches, especially in arid areas, and Wilkinson (1972:35) notes that

[r]elationships involving taming, selective breeding, castration, and other modifications to the animals involved ... are most likely to succeed if the species of animal is not moved outside its natural habitat. When observed, such movements probably indicate a high degree of technical ability, a lack of alternative economic strategies, or a failure to appreciate the requirements of the animals.... It seems to me likely that prehistoric domesticators took advantage of optimum feeding grounds before moving animals to areas where they would not be self-supporting.

Donkeys (*Equus asinus*) are native to the rugged, dry, often hilly terrain of North-East Africa, and in modern times – as very probably in antiquity – their large-scale breeding zones reflect this environment. For example, in mountainous regions such as Tibet donkeys are raised at medium-level altitudes and used in all areas except the highest (Jest and Ravis-Giordani 1985:15-17). There can be good reasons to move animals from their natural habitat: prices for the animals will be higher elsewhere, and there will not be wild herds to tempt the domesticated animals away – a common issue to the present day with reindeer and camels.

#### Donkey trade at regional markets



Figure 17: Donkey section of Kashgar market, Xinjiang, China (© Jill Goulder 1991)

In developing regions using large numbers of donkeys today, donkeys are commonly traded at huge regional markets near to the breeding zones, attended by traders and donkey-merchants from demand regions who convey the animals back and sell them at smaller markets or retail (APP II.15 and see examples below); payment may be in goods such as grain. These large markets, selling a range of

working and meat animals, have their roots in antiquity, both in Africa and in Syria, Pakistan, Baluchistan, Afghanistan, India, China (Figure 17) and elsewhere (APP II.15). Their presence, as fixed periodical meeting-points for goods transfer, may also be assumed in early times, for example on the Iran plateau trade routes for obsidian, copper and semi-precious stones, where (Zarins 1978:10) 'later economic texts from the Early Dynastic through Ur III periods document the sale and trade of both horses and hybrids from Dêr, a mountainous frontier town bordering Mesopotamia and Elam'. The traces of ancient and even modern markets, sometimes in remote areas, are difficult to detect except by traded material distribution patterns, though modern archaeological investigation can be aided by satellite imagery and isotopic analysis of dung presence (see Chapter IV.2). The nomadic pastoralists attending the seasonal markets also, today and it is likely in the past, trade with sedentary groups, providing donkeys and other livestock and goods (Blench *et al.* 2004:216, and see Chapter VIII.4 on pastoralists' links with agriculturalists). Archaeologists may underestimate the importance, in terms of exchange processes and of livestock producers' strategies, of these gatherings; to this day they are central to livestock-rearing economies, aiding efficient circulation of unneeded animals such as excess males, and they are as much channels for diffusion of ideas and skills as of animals.

#### Donkey-breeders

There are numerous historical examples of specific groups specialising in breeding or dealing in working equids, with 'gypsies' famously specialising in horse-dealing in Britain (Lawrence 1985:175). Symbiosis is sometimes an element: in 16<sup>th</sup>-17<sup>th</sup>-century AD England itinerants related to small-scale horse-rearing farmers dealt in horses for urban areas (Edwards 1983:114-16), and in 18<sup>th</sup>-century AD North America village inhabitants were kept supplied with horses by related nomadic groups (Ewers 1955:19-14). Other factors may include historical contact, as in Nigeria where 'donkeys are associated with areas of Islamic influence, and were probably introduced via the trans-Saharan caravan trade' (Blench *et al.* 2004:211), or cultural habits encouraging or inhibiting such practices. A factor may be the agricultural or pastoral bias of a region, or traditions related to consumption of donkey meat (see below). This latter factor is a likely reason for key differences between donkey and camel management practices; camels are also raised and traded by nomads and others from particular ethnic groups (APP II.15), but Khazanov 1984:97 points out that camels are also widely used for meat and milk, while breeders of donkeys need to keep other animals for these needs.

### Donkey-supply



*Figure 18: Donkeys from Gonder being sold at the thrice-weekly market in the village of Jawi in humid W Ethiopia (© JG Ethiopia 2014)*

In modern West Africa, donkeys are bred in large numbers in arid Saharan and northern Sahelian countries such as Niger and northern Mali, by specialist groups such as the Teda (Blench 2004:24, Blench *et al.* 2004:211), and are supplied profitably to more humid regions further south, where donkey fertility is lower and where humidity-related diseases, unsuitable foodstuff and cultures unused to donkey management lead to short lifespans (e.g. Blench 2000:340-42, Starkey 2011:25). Donkey merchants and traders from the south travel frequently to the huge markets to the north such as Djibo, Gorom Gorom and Dori to buy consignments of donkeys for central Burkina Faso (JG Burkina Faso 2013), and 'Hausa and Zarma traders buy the donkeys directly from the producers and take them to the border markets where they enter the Nigerian trade system' (Blench *et al.* 2004:217). A similar chain-of-supply system exists within Ethiopia (e.g. Pearson *et al.* 2001:64/67, JG Ethiopia 2014). In north-western Ethiopia, my interviews with dealers and buyers (JG Ethiopia 2014) found that individuals in drier regions such as South Gonder breed a few extra donkeys for income and sell unneeded animals at local weekly markets. These are bought by traders, who collect a group of donkeys and take them south-westwards on foot up to 200km to humid, tropical regions of high demand. The donkeys are purchased at the frequent markets in the demand-area villages (Figure 18) by individuals replenishing plough or pack

animals. The journeys with the donkeys are dangerous ones due to predators and thieves, and there may be feeding issues (Pearson *et al.* 2001:70), but the donkeys generally cooperate and follow the group (e.g. Förster *et al.* 2013:198/210); young donkeys are sold for pack, older ones for ploughing. Some farmers sell their ploughing donkeys at the end of the season and re-buy next year, but in many cases the donkeys die of trypanosomiasis and other humid-area diseases within a couple of months of purchase; many of the owners seem to accept this high loss rate (Starkey 1987:39, Starkey 1994b:3, Starkey 2011:25) and regard the donkey as a consumable, as with slaves in 18th-century AD America (Reyman and Dirks 1985:890).

Förster *et al.* (2013:197) also describe large consignments of donkeys in the present day taken 900km by donkey-buyers from Debba in northern Sudan – where the donkeys are ‘famous for their strength and endurance in heavy work and carrying loads over long distances’ – to El-Fasher market in Darfur to the west, where the drivers can sell them at three times the purchase price. Consignments of donkeys are also collected and driven similar distances for *ad hoc* demand, as when a tribal group near Timbuktu had lost most of its donkeys and camels to drought and civil war; a tribal group at Bouressa (an area with an abundance of free-living donkeys) drove a consignment of donkeys to Timbuktu for a fee (Förster *et al.* 2013:209). In Namibia in the mid 20<sup>th</sup> century AD use of donkeys was officially discouraged by authorities, who favoured oxen, so donkeys were purchased in the markets in the more temperate south and driven ‘in herds on sometimes months-long drives to Ovamboland’ in the north (Kreike 2010:98). With growing demand for donkeys in post peak-oil Africa, donkeys are also being increasingly supplied across national borders by countries with established donkey populations to neighbouring regions who lack a tradition of using donkeys (commentators describing examples are noted in APP II.15). This process may overlap with theft: Hagmann and Prasad (1995:236) report for example on high levels of donkey theft in Zimbabwe, a surprising incidence given that oxen are widely preferred here for work and donkeys are subject to prejudice as reported by a number of regional experts (APP II.34); but a likely explanation is that donkeys are being stolen for supply to neighbouring countries. Large-scale animal-rustling has a long history: Native Americans, for example, found horse-raiding easier and more prestigious as an occupation than horse-breeding, despite the good conditions for the latter (Lawrence 1985:21).

The references to donkey supply in the 3<sup>rd</sup>- and 2<sup>nd</sup>-millennium BC Near Eastern texts underline the similarly large-scale geographical complexity of the equid-breeding industry then: one of my research aims (Chapter I.1) is to bring forward this sector as a significant employer and factor in working-animal use. 3<sup>rd</sup>-millennium BC texts from Lagash and Mari indicate donkey supply centres at Dêr and Gutium in the Zagros region, Mari, and Kish in central Mesopotamia (Prentice 2010:106, Sallaberger 2014:350, Zarins 2014:160/199); these seem to be centres specialising in working equids, in contrast to the major meat-animal distribution centre at Drehem in the later 3<sup>rd</sup> millennium BC, where there is little mention of equids (see below). Milevski (2011:177/196/232-5), discussing 3<sup>rd</sup>-millennium BC southern Levant, suggests from modern analogy that donkeys were likely to have been bred by specialists ('as in the case of the Solubba of the Arabia Peninsula who breed donkeys for other tribes' (Milevski 2011:177)), and separately operated in pack caravans by merchants, agents and caravaneers. Kupper (1957:36) also describes early 2<sup>nd</sup>-millennium BC accounts of horses being bred in southern Syria, traded in Qatna and provided to areas further north, as in the Letter from Bahdi-Lim to the Hanean king Zimri-Lim; this strongly indicates development of new desirable breeding regions distinct from the indigenous horse regions to the east. Mapping the locations of working-animal transfer activities, then and more recently, can provide clues to working-animal supply and demand systems and associated large-scale activities. In 16<sup>th</sup>/17<sup>th</sup>-century AD England, horse-dealing fairs were commonly situated 'at the junction of breeding and rearing areas' (Edwards 1983:121), and 'as a general rule sellers appear to have travelled shorter distances than buyers' (p126), Pearson *et al.* (2001:63) adding from modern donkey-trade in Ethiopia that '[s]ome donkey dealers generally perceived that the greater distance between purchase and sale location, the higher the margin.'

Other early references to quality of donkey stock, and to knowledge of the best regions, are seen in 3<sup>rd</sup>-millennium BC Ancient Near Eastern texts from Ebla and elsewhere on the hybridising of donkeys with onagers: good donkeys were imported to breeding centres in or close to regions with indigenous wild onagers, in northern Iran and further west as with Hamazi in Iraq and Nagar (Tell Brak) in north-eastern Syria (Archi 1998:10, Zarins 2014:171). In early 20<sup>th</sup>-century AD Iraq, mules were still bred in Iran and Kurdistan and prized for their superior quality (Admiralty War Staff 1916:139, Zarins 2014:251-3).

Zarins (2014) summarises the textual references to donkey supply and demand in 3<sup>rd</sup>-millennium BC Mesopotamia in terms that closely describe the modern African situations described above:

mortality rates were high and longevity was at a minimum. Therefore, the net local effect was negative, and, as a result, constant purchase from the peripheral areas of Mesopotamia was necessary to supplement local breeding. (Zarins 2014:245)

Brewer *et al.* (1994:99) argue similarly that

donkey breeding in Mesopotamia was still relatively unsuccessful and stocks were replenished through trading (and raiding) with northern and eastern areas,

though this erroneously implies incompetence rather than a well-organised system of breeding of disposable donkeys in the most suitable regions, as today, with users finding economic sense in buying in healthy donkeys rather than attempting to breed them where a suitable environment (e.g. Blench 2000:340-42) or space away from farmland is available.

The modern West has lost touch with the complex nature and central importance until recent times of working equid breeding and trading, equivalent perhaps to the vehicle industry today. McShane and Tarr describe the system 150 years ago in the USA for supply of horses to urban areas:

[a]n elaborate market assigned value to animals. Breeders sold horses to owners of feeding lots. The feeders in turn shipped horses that they had broken to harness to central markets in Chicago and Kansas City. From there the horses went to wholesale auction houses in large cities. ...Secondary markets specialised in used horses, and there was much informal trading comparable to the current market for used cars. (McShane and Tarr 2006:370)

In the early 20<sup>th</sup> century AD in Britain, farmers bred and trained horses for town use, which were then returned to do farm work when worn out by urban labour:

[t]own work made far heavier demands on horses than farm work and wore them out more quickly ...The horse economies of the farm and town were in large measure complementary therefore. The one did all the breeding and schooling, the other wanted proven horses, ready-to-work. Indeed, the agricultural herd consisted very largely of mares, unbroken horses, and



horses-in-training ...while almost all horses in towns were mature. (Collins 1983:86-7)

Working animals are commonly moved seasonally to prolong their working utility; in modern Nepal donkeys spend five months at the brickworks and the remainder of the year in western regions for recuperation, and pack donkeys/ mules on the Greek island of Hydra are rotated seasonally to the hills (Brigitte Blot pers. comm. 2014); similarly camels in modern Pakistan are bought in the mountains, worked in the plains and then returned to the trader for 'resocialising' in the mountains (Raziq 2011).

As might be expected and as might be archaeologically detectable, the supply of donkeys for work from modern breeding centres to markets is often of males, females being kept for breeding (APP II.15); the market supply emphasis may lead males to be preferred culturally by buyers, and these factors lead to constrained breeding of donkeys in the usage area (Blench *et al.* 2004:213, Mutemi 2008:69, Yilmaz 2012:19). There is some home-breeding in rural regions of Africa and so some demand for females (Gebreab 1998:16, Pearson *et al.* 2001:37, JG Burkina Faso 2013), but donkey-foals can be tricky to rear successfully and their mothers cannot carry loads in late pregnancy (Pearson *et al.* 2001:30/65).

Donkey breeding and supply systems – now and in antiquity – may form a structure, varying in exact content, of small breeders, medium traders, large markets, medium merchants and small users. As described above in Ethiopia, donkeys may have been bred by individuals and then collected and taken in bulk to the demand regions by specialist operators. Sallaberger (2014:341/350) suggests that donkey-breeding in the 3<sup>rd</sup> millennium BC may have been concentrated at regional centres such as Mari and Nagar. However, in contrast to the plentiful mentions of professional donkey-herders (Zarins 2014:230-1) there are few text references to breeding apart from semi-nomadic Haneans breeding donkeys locally, as in early 2<sup>nd</sup>-millennium BC Mari texts (Kupper 1957:6-15, Zarins 2014:201/249). While the accumulation of donkeys at regional centres for onward transfer was susceptible to state control, I suggest that the systematic breeding sector itself – perhaps concentrated in remote regions – was likely to have been privately operated.

At the demand end, customers may send agents to import direct, as with an early 2<sup>nd</sup>-millennium BC Mari text of a letter rejecting the local small female donkeys and

requesting imports of better specimens from a particular area to improve the writer's herd (Dercksen 2004:258). In areas of high demand, traders may bring donkeys to regular markets as described above in Ethiopia, or to an urban 'pop-up' market as common in many parts of modern Africa in particular, where on a known day the streets of a town fill with donkeys brought in for sale (JG Burkina Faso 2103, Paul Starkey pers. comm. 2015). There are good indications that a similar system operated in Mesopotamia in the early 2<sup>nd</sup> millennium BC, where an Old Babylonian commercial letter advises a recipient 'concerning asses that you need, come here and buy asses, the asses have come up from the country' (Tablet BM 97347, CT 33 21; Leemans 1968:180, Zarins 2014:199). Foster (1977:36) and Zarins (2014:199) report on 3<sup>rd</sup>-millennium BC commercial texts from Sargonic Mesopotamia detailing trading of donkeys, including a reference in a tablet from Tello to more than 700 donkeys transferred to Lagash – a Mesopotamian demand hub – from Gutium, a major donkey-supply region in the Zagros as noted earlier. Zarins (2014:199) also refers to the many references in Sumerian texts at the end of the 3<sup>rd</sup> millennium BC to the sale by merchants of donkeys for agricultural work (as opposed to pack work – see below); meanwhile, in 2<sup>nd</sup>-millennium BC Egypt there are textual references from Deir el-Medina to water-carriers being commissioned to buy donkeys on behalf of others (McDowell 1999:75).

Zarins (2014:109/201/249) suggests, plausibly, that mobile pastoralists were responsible for the introduction of the domesticated donkey to sedentary and urbanising groups in the Ancient Near East (Chapter II.2). Certainly there is evidence from antiquity onwards of mobile pastoralists delivering donkeys to farmers and transporters; pastoralists would indeed come into contact with sedentary and urbanising cultures with rising demand for ploughing and transport animals, but as donkeys are not commonly eaten (Chapter IV.2) they are not an asset to be taken in large herds on pastoralists' long seasonal rounds. I suggest that when systematic use of donkeys emerged in the late 4<sup>th</sup>/early 3<sup>rd</sup> millennia BC, the breeding and trading of donkeys became (as today) the preserve of arid-region specialists focusing on donkey production, who then supplied consignments of donkeys, via regional markets and direct.

Today (when more donkeys than ever in prehistory are being bred and traded) there is still very little information on the modern breeding and supply process: breeders and traders inhabit remote regions and prefer to keep their activities out of official records, and as profitable entrepreneurs they are not the targets of aid

organisations. A vivid example of this invisibility, in the modern camel supply sector, is given by the 'mobile oases' in Chad, which are remote spots to which nomads bring spare camels from their herds for sale to traders (alerted nowadays by satellite phone) who take them to Libya for meat (Meerpohl 2007:138-41). Dercksen (2004:258) and Veenhof (1972:2) underline the similar scarcity of provenance information in texts, very possibly for similar reasons, about the huge numbers of donkeys used in the 2<sup>nd</sup>-millennium BC caravans described in the Kaneš texts (APP II.15).

### ***Preferred criteria for donkeys***

Although, as described above, the majority of donkeys have always been the result of unselective reproduction, there are many modern and historical examples of specialist strains of donkey developed for particular purposes; indeed Darwin in 1868 AD noted four breeds of donkey, used for different types of work (Epstein 1984:178). Donkeys from certain regions are valued as hardier, larger or stronger (APP II.15), and in many cultures there are different breeding aims for riding and for pack donkeys. A specialist in breeding or supply of 'big donkeys' is mentioned in 3<sup>rd</sup>-millennium BC texts from Mari (Sallaberger 2014:341); and in early 20<sup>th</sup>-century AD Iraq two categories of donkey were bred: for riding (large, strong, handsome, expensive) and for pack ('black, and dark brown, and is small and wiry in appearance' (Admiralty War Staff 1916:139)). In 18<sup>th</sup>-early 20<sup>th</sup> century AD Iran, similarly, the large white Baghbab donkey was favoured for riding by Muslim clerics while the small chamois-coloured Bushire donkey was the common transport animal (Floor 2003:554). In modern Egypt, Sudan and Ethiopia the preferred riding donkey is larger, stronger and faster than the ordinary pack donkey, though less enduring and hardy (Epstein 1984:177, Gebre Wold *et al.* 2004:78, Wilson 1981:141). In the donkeys in ancient Egyptian illustrations Brewer *et al.* (1994:100) detect a progression from the 'wild' size and colouring in the 4<sup>th</sup> millennium BC to 'stronger, larger, and lighter colored animals' by the 2<sup>nd</sup> millennium BC. O'Neill (1998:28) suggests that there may nevertheless be a demand for smaller donkeys for household and agricultural work, as costing less to maintain and offering more flexibility in terms of use. A particularly desirable feature for transport animals is hardiness and resistance to climate extremes, difficult work, disease, and shortages of food and water (APP II.15).

Coat colour is commonly mentioned as indicative of a desirable breed (APP II.15), sometimes even over strength or hardiness, though as Blench *et al.* (2004:211) note in Nigeria, 'Although some colours are favoured by buyers, there is little evidence that these colours are linked to the productivity or hardiness of donkeys.' Animal coat colours vary in the wild, reflecting environmental circumstances (Almathen 2011), but are of course mainly undetectable archaeologically except through DNA. References to donkeys in the early 2<sup>nd</sup> millennium BC Kaneš texts concerning the donkey-caravan trade from Assur commonly include the adjective 'black' (APP II.15), particularly when attached to a detailed list of goods being conveyed, such as '1 talent and 6 minas of tin and 5 black donkeys' (Barjamovic 2011:88). What were the attributes of these black donkeys? There are Kaneš text references to demand for large, strong young donkeys (Dercksen 2004:259-63); certainly strength is required, but very large size may not be an asset in pack donkeys, which need to be short-legged enough for easy loading and presumably catching, though long legs are useful for difficult terrain and for example fording rivers (Pearson *et al.* 2001:65). It may be that the 'black donkeys' specified are not special ones but the opposite: the writer is indicating that the donkeys listed are common pack donkeys rather than expensive riding animals. Meanwhile, training/ experience is rarely mentioned as a desired attribute (e.g. Pearson *et al.* 2001:65), probably because donkeys are easy and quick to train for work (Chapter IV.2).

There is a general tendency for size reduction in domesticated animals, through lower access to nutrition and exercise than in the wild (Anthony 2007:202), or for reasons of stress or breeding in overstocked conditions (Hemmer 1990:99). There may be active selection for small, more manageable animals for meat, milk or wool/hair, and smaller animals may be more likely to survive than in the wild among predators. However, among working animals there may be active selection for large size, and changes in size of faunal remains compared with the wild may also reflect hunting strategy regarding the former, or environmental factors or episodes of genetic isolation (Levine 1999a:31 concerning horses). The size criterion is nevertheless employed or referred to by a number of zooarchaeologists and other commentators investigating early donkey finds in the Ancient Near East (APP II.21); but any size reduction over time in domesticated donkeys in the Ancient Near East appears to be slow and non-linear (Marshall *et al.* 2014:6154, Shackelford *et al.* 2013:4170-1). This lack of overall size reduction may relate to the elite status of the donkey specimens examined (though see Chapter II.1 on 'elite' donkey burials), or to the low-management regime of donkey-keeping and continued recruitment from

the wild (APP II.21) that militates against domestication features seen in other species. Fiona Marshall, discussing detection of domesticated donkeys in their native continent of Africa, argues that

some of the same husbandry practices that contribute to the scarcity of donkeys in archaeological sites also suggest that they will be difficult to distinguish from wild ass. African herders place a premium on the strength of donkeys, and management of the donkey is minimal. Under such conditions there is not likely to be strong selection for size decrease or morphological change. (Marshall 2007:379)

Caroline Grigson (1993:645-6) cites reported evidence of domesticated donkeys eventually reducing in size, but (2003:219) notes the uncertainty of this criterion, recognising the desirability of such an indicator as (2003:220) '[t]here are no other really reliable anatomical criteria for the distinction of wild and domestic equids'. Shackelford *et al.* (2013:4170-1) and Vila (2014:434) report that some early examples found are indeed smaller than their wild equivalents, but the donkeys with work pathologies buried at early 3<sup>rd</sup>-millennium BC Abydos in Egypt are as large as their wild equivalents, as are examples from the later 3<sup>rd</sup> and 2<sup>nd</sup> millennia BC in north-eastern Africa and at Tell Brak in Syria. Dercksen (2004:257-8) records the heights of donkey remains (some in ceremonial contexts) from 3<sup>rd</sup>-millennium BC Mesopotamian sites as ranging from 109-129cm, with a slight decrease over time to the donkeys at late 3<sup>rd</sup>-millennium BC Tell Brak (109-115cm). Clutton-Brock and Davies (1993:210) report on the Tell Brak finds that these donkeys therefore differ little in height from 'the short-legged donkeys of the present day [in Syria] that commonly stand about 11 hands (112cm) at the shoulders', setting aside taller specialist riding-donkeys of 123cm (Wilson 1978:185); Wilson sets typical modern African donkey-height at c.105cm (APP II.28).

### ***Breeding of donkeys for caravans***

Animal owners supplying the caravan industry (with donkeys, reindeer, camels, yaks/ dzos or llamas) may either sell or hire out their animals to merchants, sometimes with themselves as drivers, or they may organise caravans themselves for the traders (APP II.36). These systems could be categorised respectively as symbiotic and integrated, and their incidence may reflect the original impetus for caravans – 'push' by breeders adding value by transporting goods, or 'pull' by entrepreneurs requiring transportation services, as Retso (1991:189) suggests for

the Arabian frankincense trade in the 1<sup>st</sup> millennium BC. Joffe (1991:28) suggests that exchange in the 4<sup>th</sup> millennium BC between the southern Levant and Mesopotamia was 'mediated over great distances across arid zones by nomadic or semi-nomadic groups', with or without donkeys – the integrated system – though Oren (1989:401) suggests that in northern Sinai this process may have been conducted by the town-dwellers, implying that the nomads were carriers and donkey-drivers working symbiotically with merchants (APP II.36). Milevski (2011:177/196/232-5) is cited above as suggesting separate donkey breeders and caravan-operators in 3<sup>rd</sup>-millennium BC southern Levant, and goes further to suggest (see Chapter II.2) that either or both categories may have formed socially-separated groups with donkey-related cultic adherences manifested in donkey figurines and/ or elite donkey burials.

The system used could be a valuable pointer to the overarching political structure of the period, as it could be argued that in authoritarian regimes responsibility for caravans is more likely to lie with animal-owners than with independent merchants. Earlier interpretations of 3<sup>rd</sup>-millennium BC Mesopotamian exchange activity assumed state control, but there is a growing body of evidence from texts and archaeology that there was also privately-organised long-distance trade by self-sufficient communities (Chapter II.1). There is almost no reference in 3<sup>rd</sup>-millennium BC official texts to what must have been a significant process of supply of donkeys for long-distance caravan work, apart from a passing mention in a Jemdet Nasr-period text (IM 23435) of 'travel donkeys' as distinct from ploughing donkeys (Zarins 2014:199). This contrasts with the common official listings of transactions concerning donkeys for agricultural work (see above).

Symbiotic systems, with breeders and caravan-organisers separate but depending to a greater or lesser extent on each other for a living, are widely found today. In modern northern Africa, camel caravans are supplied with animals by particular ethnic groups (APP II.15) who raise camels for meat and whose subsistence level is assisted by selling their excess males to caravaneers. A different symbiosis is practised in Tibet, where the yaks and yak-cow hybrids used for pack transport are bred by an ethnic group specialising in this business, the sama-drog mobile herders (Downs and Ekvall 1965:181-2); their mobility allows for the animals kept by the high-altitude yak-herders to be transferred to the caravan start points. In all cases, breeders take back unsuitable animals (uncooperative, ill, injured) and rehabilitate them, replacing them meanwhile with fresh animals. Even closer symbiotic contact

occurs among reindeer-herders, who generally hire rather than sell their animals to caravan-organisers, and may hire themselves out in addition as drivers (Ingold 1980:134-5/251).

Cultural and historical factors have brought about a complex tapestry of symbiotic versus integrated camel-caravan systems in the Middle East and Asia. Throughout camel-herding history it has been the practice of some Arabian groups to breed camels and others not, and for complex variations in organisation and driving to apply. Sweet (1971:207-8) describes how in modern northern Arabia city merchants organise the caravans, while in southern Arabia they have historically been organised and driven by camel breeders. A similar dichotomy applies in China and neighbouring Mongolia (Lattimore 1941:156), though perhaps for political reasons as much as cultural.

Unlike camels, reindeer and yaks, donkeys are in many cultures not used for meat (see below), which significantly alters the economics of raising animals for caravan use. Unlike these other animals, too, donkeys do not congregate naturally in large herds (APP II.26). As described above, donkey-breeders in modern Africa raise their animals in remote, arid regions and sell them in a continual flow via large markets to donkey-merchants, who keep smaller groups of donkeys near urban and agricultural areas, supplying individual farmers and transporters and occasionally replenishing caravans. Meanwhile modern merchants organising caravans may buy in donkeys from breeders, as for the early 2<sup>nd</sup>-millennium BC Aššur-Kaneš caravans (APP II.15), or sometimes breed their own; the dual outlets for donkeys – to donkey-merchants for local employment and to caravan-organisers – help to make large-scale breeding of a non-meat animal logistically viable. In the Kaneš system, donkeys were also hired in at times, though this may be from local owners rather than the breeders themselves; and there are accounts of donkeys being given and received as payment, often as part of the ‘package’ including the goods. There is little textual information on the provenance of the Kaneš donkeys, with only isolated references to locations for donkeys being bought and sold, for example at a market at Šinahuttum in eastern Anatolia and at gigamlum, paddocks and breeding centres near Aššur (APP II.15).

As well as pack animals for the start of a caravan journey, a supply of replacements was and is still required along the route, to deal with erosion of animals due to illness, mortality, uncooperativeness, escape and theft. The Kaneš texts report high

donkey loss rates from the caravans from Aššur, replenished by buying or renting *en route*, and fresh donkeys had to be found for each new caravan as most donkeys were sold in Anatolia on arrival (APP II.15). The donkey sale price in Anatolia equalled the purchase price, perhaps due to the ex-caravan animals' proven strength (Holladay 2001:184-7) and to demand, though sometimes there must have been an excess of donkeys on the Anatolian market. While a few equid bones have been found in the Anatolian area of Kültepe (Atici 2014:203), possibly indicating some use for meat, the great majority must have been sold on for local work.

### ***Breeding of cattle***

Selective breeding of cattle for particular environments or purposes has a long history (McCann 1995:48), and evidence of breeding for work suitability may be visible zooarchaeologically. Ur III and Old Babylonian texts from the late 3<sup>rd</sup>/ early 2<sup>nd</sup> millennium BC describe cattle-supply stations at Sippar, Kish, Larsa, Girsu and Ur (Heimpel 1995:110, Stol 1995:180), including those owned by royal women (Stol 1995:180), with indications of a focus on breeding for work strength (Stol 1995:184). A revealing slant on the recording practices of the late 3<sup>rd</sup> millennium BC is given by Liverani and Heimpel (1995:128-9), re-examining an Ur III tablet listing annual figures for growth of a herd of cattle over ten years and finding them wholly unrealistic in annual terms; as the administrators do not have access to the actual figures, they are providing a statistical model which provides a reasonable breeding 'goal' figure at the end of ten years.

Cattle, as with donkeys, flourish in certain environmental conditions and not in others, for reasons including disease and lower fertility, so in many regions of modern Africa and elsewhere there have traditionally been breeding centres from which cattle are supplied to other regions via traders (APP II.19 and see below). There may be an element of working-animal breed specialisation, with farmers owning beef cattle sometimes nevertheless buying in working oxen of a particular breed (JG Burkina Faso 2013). Cattle have throughout history been widely kept for meat and milk and so the breeding, buying and selling process often relates to this rather than to work use (de Wilde 1967:107). A potential issue with supply of working cattle is the common division in Africa between cattle-herders and agriculturalists, described in Chapter VIII.4; Phiri (1994:145) and Tiffen (1976:128) report that specialist herders are at times reluctant to sell young oxen suitable for



work as these animals will gain profitably in meat value (APP II.12). At a village level there may be farmers who gain income from buying, bringing on and selling oxen (APP II.19), and at the individual end farmers who breed their own working cattle (Halstead and Isaakidou 2011:62), regarding working oxen as a depreciating equipment asset, with fodder running costs (Kruit 1994:478).

In the 19<sup>th</sup> century AD in Ethiopia, farmers in the north-eastern highlands of Tigray and Lasta benefited from an elegant multi-point arrangement for maintaining their ox-based plough agriculture, involving donkey-caravans (APP II.22), offering potential parallels with systems in antiquity.

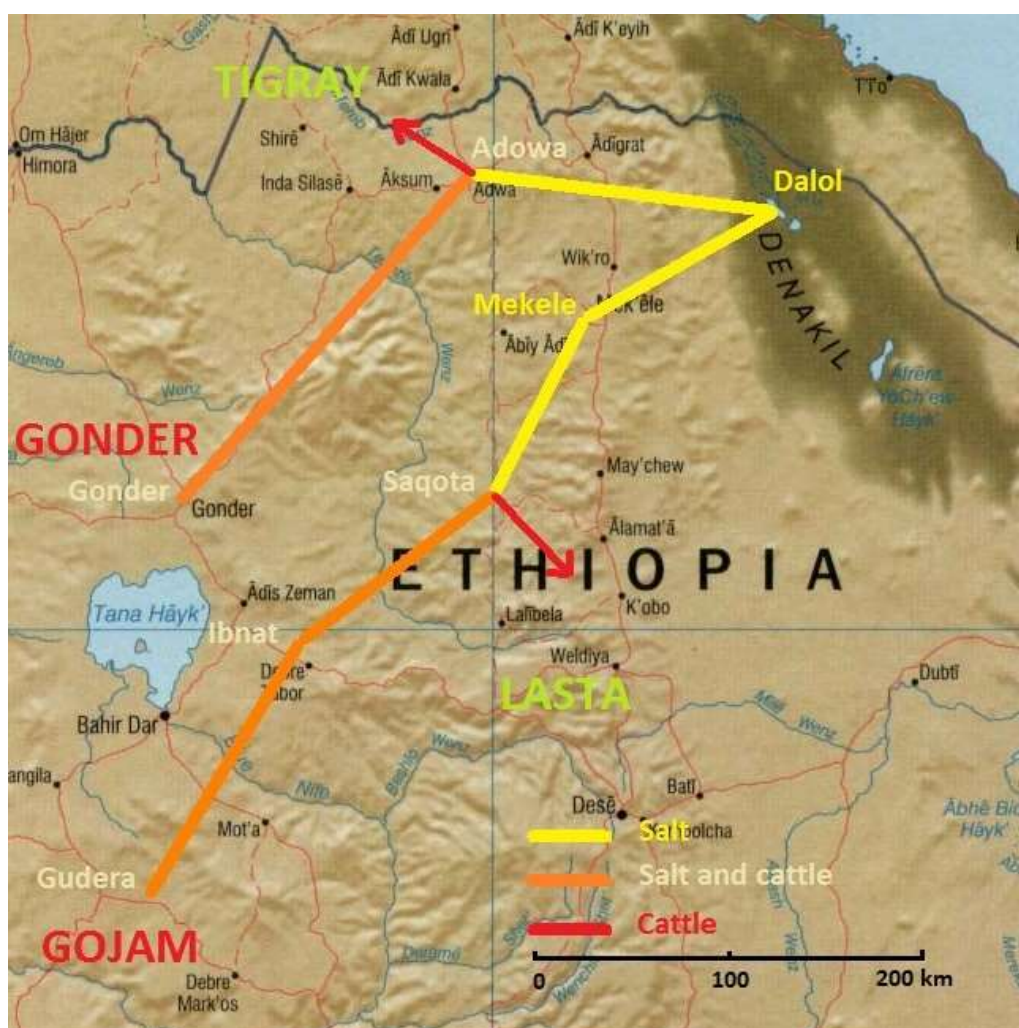


Figure 19: Examples of movements of salt and cattle in 19<sup>th</sup>-century AD Ethiopia (© Jill Goulder 2015, on template from [www.worldofmaps.net/en/africa/map-eritrea/map-eritrea-northern-ethiopia.htm](http://www.worldofmaps.net/en/africa/map-eritrea/map-eritrea-northern-ethiopia.htm), open access)

The Ethiopian highlands are fertile but feature heavy clay and steep slopes, workable by oxen but not easily by equids; however, the climate limits the

reproductive capacity and lifespan of cattle. Oxen were vitally needed as the continuation of annual cultivation was essential, under tenure arrangements, for farmers to maintain their land. The Lasta highland farmers were able to buy cattle for work at the weekly market at Saqota; these cattle had been purchased by Saqota merchants taking Danakil salt south-west to markets such as Ibbat; merchants from the cattle-breeding areas in Gojjam to the south-west brought cattle, cloth and coffee to Ibbat to exchange for the salt, and the cattle were then taken to Saqota market to sell to the farmers. The salt was brought up (as to this day) by donkey/ mule/ camel caravan from the Danakil depression in the east to Mekele in Tigray, and on south-west to Saqota market. Similarly salt was conveyed to Adowa, by animal or donkey transport, for exchange for cattle from regions such as Gondar. The system was huge in scale - there are reports of salt-caravans of 15,000 donkeys, and of 21,000 cattle/ week exchanged at Saqota – and extensive: from Dalol in Danakil to Mekele is 150km, Mekele to Saqota 100km, Saqota to Ibbat 150km, Ibbat to Gondar in Gojjam 150km (see Figure 19). The system uses no facilities not available in 3<sup>rd</sup>-millennium BC Mesopotamia, and relies, as in that period, on large-scale systems and organisation.

## IV.2 Working animal husbandry and training

### *Cycle of rearing working animals*

In modern times, in Africa and elsewhere – though close comparison of cattle in antiquity with modern breeds would be inappropriate (Urga and Abayneh 2007:3-4) – oxen destined primarily for draught are typically put into training at 3-4 years of age and worked for 4-5 years or sometimes longer before they become too fat and are sold for meat (APP II.17). Schmitz *et al.* (1991:80) and Starkey (1981a:3) make the point that draught work accelerates weight gain, as feed is turned into muscle; so – as might have been recognised in early periods – a working ox's monetary value appreciates over time (e.g. Joubert and Kotsokoane 2000:12, Sosovele 2004:107). If draught is secondary to meat production, male calves may be fed up, trained relatively young (perhaps at 1½ -2 years), worked for a season, or for a couple of years while they gain weight, and sold for meat (APP II.17). Male cattle not destined for draught are often slaughtered below mature weight if feed costs make further fattening too expensive (e.g. McCown *et al.* 1979:317); but if pasturing is cheap, animals may be kept on for longer (Delgado and McIntire 1982:188). Russell (1998:42) notes that as killing an ox provides too much meat for one family, sharing or exchange arrangements would need to be put in place.

An Old Babylonian text from the early 2<sup>nd</sup> millennium BC records cattle being trained for ploughing in their third year (Stol 1995:183); then as now training age was likely to be contingent on the good condition of the animal (Johannsen 2011:16). It is easier to train young animals, but it may be a higher-risk strategy as there is a greater mortality rate among young cattle (Blench 1997) and the feeding/ training investment may be wasted. A factor underlined in late 3<sup>rd</sup>-millennium BC Girsu texts is the erosion of the working cattle population, with cattle dying from natural causes or from predators, and disappearing through escape or organised theft by cattle-rustlers (Heimpel 1995:101-110). Another issue may be the location of cattle (see below on herding of working animals): cattle may be regularly taken long distances in search of grazing pastures and water, making the timing of training difficult.

One of the means used for detecting the advent of ox-ploughing at Ancient Near Eastern sites is calculation from faunal remains of the percentage of cattle in the total animal record in the settlement: an increase to 20 percent is suggested as the threshold for use of deep ploughing with oxen, for example in the Late Chalcolithic

at sites in the southern Levant (Bourke 2001:117, Philip 2001:187, Wapnish and Hesse 1991:26-7), compared with Sasson's (2010:56) suggestion of a common proportion of 15 percent at Near Eastern sites. Sherratt (1981:289) assumes that a short ploughing season would require the keeping of a herd of cattle, and some modern analyses of working cattle management also conclude that a 'supporting' herd of some size may be necessary for the secure provision of the needed number of working animals at any one time. McCann (1995:70), for example, points out that use of oxen for ploughing brings with it a need for a livestock system which produces, trains, and maintains a stable supply of oxen; for a pair of working oxen this might require (McCann 1984:6 and 1995:48, referring to modern Ethiopia) ten head of cattle (two oxen, two young "apprentice" bulls, a stud bull, and four or five cows). Peters (1986:138) reports an estimate that a herd of 30 cattle is required to maintain four draught oxen, and Lawrence and Pearson (2002:101) calculate that to maintain 100 adult working cattle, a total herd size of 130-350 is required, depending on birth rate, the age at which animals start work, the age at which they die and which sex is used for work.

Other commentators differ on the validity of this model. Sasson (2010:48) examines both recent usage of working cattle in Israel and evidence of their presence at sites there in antiquity and concludes that 'cattle abundance does not point to agricultural intensification'. The 'threshold' assessment, too, does not take account of growth in other uses of working oxen, such as transport and other agricultural traction. The calculations assume that only male cattle are used for work, which is by no means the case in many regions worldwide today (see Chapter III.2 on cows ploughing). These calculations, too, do not take account of firstly the incapability of small-scale farmers of maintaining a 'supporting' herd (e.g. Peters 1986:138), particularly in regions where cattle do not thrive, and secondly the common informal system where these 'supporting' animals are often spread around the area, perhaps in grazing herds many kilometres away (see below on the herding of working animals), with a sufficient number of ready animals emerging as needed and exchanged and shared among the wider community (e.g. Farnham 1997:105). Lubumbe (1994:366) describes local systems in Zambia reliant on a community-wide reserve of oxen to support working animal use; de Wilde (1967:107) describes in West Africa farmers keeping at most one spare animal, and relying on sharing and on exchange between farmers of labour and plough-teams, while (as noted below in the paragraphs on training) experienced users may recruit cattle *ad hoc* for work from their general herd, making the presence of working cattle hard to detect

archaeologically in what can seem largely a traditional meat/ dairy herd (Johannsen 2005:47). New cattle for work may also come from specialist breeders far away, as described in Chapter IV.1 on the breeding of working cattle, notably Redding's 1992 account of the zooarchaeological identification of a 3<sup>rd</sup>-millennium BC Egyptian cattle-breeding centre by the low incidence of cattle bones (notably those of prime age) combined with the high presence of cattle dung. Finally, account is not taken in the cattle-threshold model of cattle herds kept for prestige reasons, as noted in Chapters VIII.1, 2 and 4. The subject of detection of working animals through modelling from faunal remains is revisited in Chapter IX.1.

Data on donkey and cattle reproductive speed, age of starting work and particularly lifespan are often based on accumulation of experience, with little meaningful statistical material; the notes in this paragraph are a synthesis of numerous accounts (listed in tables in Appendix II, specified below) from countries making significant use of donkeys, for the purpose of comparison between the two species of working animal. Donkeys are much longer-lived than cattle (APP II.17), often living beyond 30 years in suitable environments; they are disease- and parasite-tolerant (APP II.3) and show few clinical symptoms and signs of pain (APP II.26). In difficult working environments such as Ethiopia life expectancy – or at least working life – may be 13 years or less (APP II.17), with a generally longer working life on farms than when employed by pack transporters (Pearson *et al.* 2001:43); in very humid areas they may only live for a couple of years from their arrival from the arid zones where they are bred, dying of trypanosomiasis or other tropical-region diseases (see above). Donkeys can carry loads from the age of 2½-3 years (APP II.17), and their longer potential working life than cattle makes for a better lifetime return on breeding and training (Jones 2008a:6, Kaumbutho *et al.* 2004:98), though the higher breeding rate and meat value of cattle can be set against this (APP II.12, II.17). Zarins (2014:256) reports from analysis of 3<sup>rd</sup>-millennium BC Mesopotamian texts that donkeys at the time seem to have started work at a similar age to now, but to have reproduced more slowly and died younger.

### **Castration**

Osteological evidence of castration is one of the potential indicators of the early use of male cattle for work (Baker 1984:255, Bartosiewicz *et al.* 1997:94, Cuijpers 2010), though the correlation is far from exact – and of course does not aid in

detection of working cows (e.g. Piggott 1983:35). Castration of bulls is widely known to produce a quieter temperament (e.g. Reh 1982:78), but in modern times quite commonly working bulls are not castrated (APP II.17); reasons for refraining from castration of working bulls range from a need for males for reproduction, the greater strength and resilience in difficult conditions, use of a docile breed, or simply lack of good knowledge of the castration process and benefits (Blench 1997:15, Otchere *et al.* 1988:236). Zeder (1991:29) notes that

[l]arge-scale cattle raising for draft animals requires that a higher proportion of castrated males live a good deal longer than is conducive to efficient management of cattle for edible reasons;

and it is the strongest males who are selected for work so 'the breeding bulls may be genetically inferior in body size and conformation' (Starkey 1991:78). Evidence of castration in the past may therefore indicate more focus upon ploughing animals for arable than raising for beef (Starkey 1991:78), or perhaps upon animals intended for specialised work requiring good control, such as hiring out for work or complex tasks such as forestry, and pack and riding (Starkey 1992:19, Nicolaisen 1963:53).

The age of castration may give more detailed clues. Evidence of castration of very young bulls may indicate a focus on beef production and a desire for a docile herd; castration of bulls intended for draught is likely to be later to allow full development of strength (APP II.17). However, late castration affects the animal's strength and character adversely (e.g. Barrett *et al.* 1982:35) and so, in an environment where cattle move from owner to owner, a mature bull put to work may be left uncastrated. In a highly-controlled environment, with working animals being managed from birth to death as in 3<sup>rd</sup>- and 2<sup>nd</sup>-millennium BC Mesopotamia, there are Sumerian descriptions of male cattle destined for work being habitually castrated at an early age and well before their first use for work, possibly indicating an overriding requirement for early docility (Maekawa 1979a:108-9, Stol 1995:184).

Castration may have originated in 'fertility magic' (Barclay 1980:6), with the animal then found to be more tractable and more likely to bond with humans, as well as less inclined to drive other males away from his herd (Barclay 1980:6). There are examples of castration for other reasons, such as 'domesticating' the head of a wild herd, for example of reindeer (Aikio 1989:232) to ensure their continuing local presence. 3<sup>rd</sup>-millennium BC Sumerian texts use similar terminology for human males castrated for labour as for bull calves castrated for ploughing, and there is a

theory that the practice of human castration (to halt reproduction or induce docility) derived from this treatment of animals (Campbell 2005:95, Maekawa 1979a:95, Tani 1996:403-5).

Incidence of castration of working donkeys in modern societies varies by region, sometimes for cultural reasons (APP II.17), but is not customary. Male donkeys are not generally aggressive when working, and owners may be conscious of the advantages of owning an intact male, in view of the fairly slow reproductive process. The physical consequences of castration of donkeys are much less marked than with bulls, and accounts of beneficial changes in strength and temperament are largely anecdotal (APP II.17). Uncastrated males may exhibit difficult behaviour in the vicinity of fertile females and may roam in search of them, affecting availability for work and ease of handling, and there are accounts of *ad hoc* castration to deal with such issues (APP II.17).

Maekawa (1979a:102) notes that in Sumerian texts female equids are more commonly used than males for ploughing (were males instead employed for example for pack?), and that males used were systematically castrated – perhaps because of potential issues with the largely female teams; Heimpel (1995:108), though, reports from Girsu texts that in the late 3<sup>rd</sup> millennium BC male ploughing donkeys were not necessarily castrated. The use in 3<sup>rd</sup>-millennium BC Mesopotamia of constraint features such as genital strapping is mentioned in Chapter IV.1 above. Pearson *et al.* (2001:66) report that in Ethiopia female donkeys are used in the dry season for transport and in the wet season for breeding, and high-intensity usage in the 3<sup>rd</sup> millennium BC may have included restraints on breeding during the working season.

Uncontrolled breeding is not typically a major concern for modern individual donkey-owners, but Marshall and Weissbrod (2011:S406) report on selective castration of donkeys by Maasai pastoralists to eliminate undesirable physical or behavioural traits from the breeding pool, and Jones (1997:71) comments on the potential for reduction in size and strength if weak animals are not eliminated in this way.

### ***Herding of working animals***

In regions with indigenous donkeys, tamed adult donkeys might require periods of confinement or hobbling before they could be left free to graze without fear that they would rejoin the wild herd (Marshall and Weissbrod 2009:74, Nicolaisen 1963:107-109); but in sub-Saharan Africa, and in ancient Mesopotamia, this does not apply. The many African and other accounts of semi-wild donkeys rounded up *ad hoc* or seasonally for work (as suggested for early donkey use in North Africa (Chapter II.2 and Figure 9); see Glossary) invite comparison with the seasonal rounding-up for work in many regions of reindeer, camels and horses (APP II.14).

Such a commensal relationship is demonstrated for example in the Turkana region of Kenya, where groups of donkeys live freely but are familiar over time with the pastoralists with whom they share a range, as representing an occasional source of salt, well-water and protection (Tchernov 1984:92 describes passive-host benefits of commensalism) in exchange for cooperation during camp moves; the pastoralists recognise individual cooperative donkeys, and have sophisticated skills in finding and getting close to them (Stephen Blakeway pers. comm. 2017).

Commensalism may be regarded as a one-sided symbiosis in which members of one species are benefitted (the active commensal partner) while those of the other species are neither benefitted or harmed (the passive host). (Tchernov 1984:91)

Groves (1974:159) reports on

donkeys in the Sahara that roam freely but are owned by different people who, when they move from place to place, re-capture them, load them up and take them along – then release them at the next stopping-place.

As outlined earlier too, the common presence in the past and present of free-roaming herds of horses, semi-tamed and interacting regularly with humans, acknowledged as the property of an individual and employed as a work resource as needed, may again give clues to the constitution of large donkey herds reported in antiquity. An Egyptian text from the mid-3<sup>rd</sup> millennium BC refers to an individual owning more than 760 donkeys (APP II.21), but these were very unlikely to be kept as large captive herds: donkeys naturally live in small groups rather than large herds, and are capable of returning home unaccompanied (see Chapter III.1), and their valuable ability to roam widely and find rough food for themselves would be severely restricted (see below) if kept captive in large groups. A suggested



explanation is that most of the donkeys concerned were out working, in caravans for long periods or in the temporary care of individuals using them for a range of agricultural and transport work, rather as an owner of a fleet of rental vehicles nowadays does not expect to be housing many of them at any one time.

In free-roaming herds of donkeys, numbers are augmented by natural birth and by unwanted donkeys being abandoned by human users (Fielding 1987:27), and donkeys roaming free are well-equipped to deal with predators and to find food and water (Chapter VI.1). In more domestic circumstances, herding practices for working animals vary significantly worldwide according to circumstances and culture, but donkeys have often traditionally been left to graze unguarded, in mixed natural groups outside the settlements, as they are not commonly used for meat (APP II.12) so are less subject than cattle to theft. Arrangements may be seasonal, depending on the climate and uses to which donkeys were put (Kreike 2010:99, Marshall and Weissbrod 2009:70, Wells *et al.* 2004:207). Donkeys may also be herded (often by children (APP II.5)) on verges and communal land or with other livestock (APP II.14, and Chapter VI.1). Donkeys in the wild typically graze at night (Chapter VI.1), but in Africa at present they are increasingly being corralled or kept near settlements at night as demand for donkey hides for export (and so theft) rises (APP II.14 and see below).

Oxen are considered to require a good deal of attention from their owners (e.g. Bradbury 2010:8, Sosovele 2004:107), in both care and general supervision, including the sometimes elaborate measures necessary as they need long periods in daytime to graze and ruminate (unlike donkeys), and daily access to water (see Chapter VI.1). Several accounts of working oxen in Africa refer to their unfriendly and sometimes aggressive nature (see APP II.2 on handling of working animals), an element cited as constraining women from working with oxen (Chapter VIII.3) although as noted throughout this thesis cattle are habitually handled and herded by women and children (Chapter VI.1). The suggestion of using cattle from semi-wild herds for work is never mooted by commentators; Ingold (1980:140) notes that 'untamed cattle could only be managed on a ranch basis; ranch cattle are agile and fierce', though Groves (1974:159) reports that 'in Assam there are cattle that live their lives free in the forest, but come to the villages to be fed, milked and slaughtered' (but not worked). Cattle temperament can be improved by frequent contact with humans from when young, and by working regularly with the same individuals (APP II.2 and see below on training of working cattle).

Pollock (1999:103), examining gender in late 4<sup>th</sup>-millennium BC depictions of humans tending animals, suggests that it appears to be men who feed animals, individuals displaying no gender indications who master animals, and mainly women or genderless individuals who carry out other activities involving animals. Zarins (2014:230-31) records references to apparent professional donkey-herders in the late 4<sup>th</sup> millennium BC (in Fara and possibly Uruk Archaic texts) and mid to late 3<sup>rd</sup> millennium BC (late EDIII/ Old Akkadian texts from Ebla, and an Ur III text (BM 19984) concerning rations for an overseer of equids), with (p238) a table listing 'Personnel Associated with the Girsu Equids in the ED IIIb Period'; he remarks (p256) on the increasing mention from the mid-3<sup>rd</sup> millennium BC of stables and compounds for equids. Landais and Lhoste (1990:224) note that little work has been done in modern Africa on evaluation of the labour required for animal husbandry, especially in the case of cattle, but that the value added can be high, particularly as animal feeding and herding work is often carried out by quite young children (APP II.5 and Chapter VI.1) or by indigent family members. McCann reports from West African study results that the additional labour needs for working oxen

are distributed throughout the year and can be absorbed by younger members of the household (average age of livestock caretakers in the West Africa case was 12.6 years). (McCann 1984:4)

Ndiamé (1988:257) describes how in Senegal it is often a 10-14 year-old child who is in charge of livestock feeding. In a study in Burkina Faso reported on by Singh (1988:31), 50% of the children's household and farming labour time was spent this way, with older male children in particular concerned with animal traction activities.

Hobbling of animals, as discussed below, also reduces herding burdens where crop protection and straying are more of an issue than predation and theft.

### ***Animal theft and corralling***

Late 3<sup>rd</sup>-millennium BC texts from Girsu and the 2<sup>nd</sup>-millennium BC Archives Royales de Mari (ARMT II 123:15-24) show that cattle raiding was a significant activity (Heimpel 1995:106, Matthews 1978:104-5); Anne Porter (2012:22-3) discusses likely political causes, but Matthews (1978:125) notes that the raiding system has practical and social effects, as raiding reduces the tendency for

'clumping' of large herds owned by the very rich, evening out social inequality and also reducing the effect of disasters such as drought. The problem of animal theft is not confined to working animals, but as farmers point out, trained animals are more docile and easier to steal (APP II.16), and the lost investment is greater. Before the time of horses for riding (which allowed animals to be driven rapidly away), large-scale theft may have been more likely in populous areas where issues of concealing stolen animals are fewer (Russell 1998:49) and more disposal outlets are available. Urban populations, too, may generate a high demand for meat (Schmitz *et al.* 1991:80). A modern urban issue mentioned by Wells *et al.* (2004:207) is the killing of donkeys in South Africa, apparently for reasons of competition between carters; in rural areas this manifests itself as theft or unauthorised use of donkeys. This links with Porter's (2012:23) suggestion that raiding in Mesopotamia, rather than a simple expression of need, was more of a "'political instrument'" resulting from 'certain kinds of conditions, particularly conditions of disequilibrium.'

High incidence of theft – or the fear of it – can deter farmers from using working animals at all, as reported in modern Nigeria by Blench (1997:41) and in Cuba by Henriksson and Lindholm (2000:40). It may also affect choice of working animal in favour of donkeys over cattle, as the former have lower economic and social value (Sosovele 2004:109) and are not eaten in many cultures so theft incidence is lower (APP II.2); trained cattle are, too, a valuable asset as they require more training than donkeys (see below). There are multiple reasons as well as fear of theft for keeping valued animals in pens or corrals, or within the village confines: fear of straying, predators, protection from heat, cold or damp, protection of growing crops, collection of dung, intensive training, convenience of keeping working animals nearby (APP II.19). Corraling animals raises feeding and watering issues, as fodder needs to be carried, or the animals have to be taken long distances to drink and graze; evidence of corrals may therefore indicate an intense level of raiding/ theft.

Little attention has been paid until recently to the archaeological detection of corrals and other arrangements for restraining animals used for work (Olsen 2006:93). McShane and Tarr (2007:125) point out that even in 19<sup>th</sup>-century AD United States written history, '[s]tables rarely make it into histories of the built environment, although they constituted a substantial part of the environment'. Structures for keeping animals may often be temporary, making detection tricky; even sedentary groups shift their animal pens at times to fend off insect infestation and diseases (Russell 1988:89), while corrals for donkeys are likely to be small as they are not

normally kept in large numbers (Marshall and Asa 2013:491). Existing trees or poles are universally employed for tethering of animals; correlation of post-holes with animal-tethering is very problematic, though Oates and Oates (2001:41) report that in the famous building in 3<sup>rd</sup>-millennium BC Tell Brak in northern Mesopotamia, where several complete donkey skeletons were found, '[t]he presence of live donkeys in the courtyard is also attested... by the presence of herbivore dung and the outline of stakes still used to tether donkeys at the present day'. More clues may obtain in treeless regions: possible tethering-holes for animals (used to this day for tying donkeys) have been identified in a cliff-face at a 3<sup>rd</sup>-millennium BC mining site in Egypt (Kuhlmann 2002:133), and Brewer *et al.* (1994:86) report that tethering-stones are used to identify Dynastic Egyptian cattle-pens. Donkeys are sometimes simply hobbled (APP II.14), though Barker (1964:71) records that in Australian caravans donkeys – unlike camels and horses – stayed nearby without hobbling. This practice is difficult to detect archaeologically, though Baker (1984:254) notes that exostoses (bony lumps) on limb bones can indicate hobbling.

Palmer *et al.* ((Palmer, Smith &c) 2007:369-79), in an ethnographic study of Bedouin groups in the Wadi Faynan in southern Jordan, record the archaeologically-inconspicuous nature of animal-management arrangements: trees for tethering donkeys, caves for penning animals (as in Figure 20 below), predator-deterrence through flapping fabric tied to sticks. An experimental process was carried out in the 1970s in East Africa where an abandoned pastoralist camp, last inhabited 10-20 years before, was investigated for archaeological evidence of a pastoralist lifestyle (Robertshaw 1978:29). No postholes, for human or animal habitations, were found, but dung was evident in what was seen from the surviving fence to be an animal corral. At the time it was concluded that no detectable evidence of animal-keeping would survive at prehistoric sites, but more recent technologies in micro-analysis of sediments make it possible to identify elements of dung remains indicative of species and diet (Olsen 2006:93, Shahack-Gross *et al.* 2003, Shahack-Gross 2008) as well as of penning and annual cycle of on-site presence (Albert *et al.* 2008:57-8, Redding 1992:102).

Unlike cattle dung, the presence of donkey dung accumulations (outside their natural habitat) is a significant clue to their working use; detection of dung deposits is gaining ground as an indicator of pastoralist and other enclosing of animals (Chapters IV.1-2). For example, at a 1<sup>st</sup>-millennium BC caravan waystation in

Yemen, Fedele (2014:190) reports concentrations of camel and donkey coprolites outside the waystation walls, indicating likely enclosures for the pack animals.



*Figure 20: Rural animal-pens, NW Oman (© Jill Goulder 2013)*

Donkeys enclosed at night by pastoralists and farmers may be kept in specific enclosures away from cattle, to avoid horning incidents (JG Ethiopia 2014, Marshall and Weissbrod 2009:72), with consequent distinct dung accumulations.

[M]icromorphology, phytolith concentrations, mineral assemblages and the isotopic composition of organic nitrogen could be used to detect the

presence of ancient donkeys [sic] dung following approaches developed by Shahack-Gross and colleagues (Shahack-Gross *et al.* 2003, 2008) to identify cattle, sheep and goat dung in degraded sediments in prehistoric African pastoral sites. Because equids are not ruminants, larger fragments of vegetation make donkey dung readily distinguishable from that of cattle, sheep and goat. Pellet size and shape, hoof conformation and trampling morphology should also distinguish equid from bovid accumulations. (Marshall and Weissbrod 2009:75).

Shahack-Gross (2008:984) notes though that dung from browsing animals (and therefore donkeys) features fewer phytoliths than that from ruminants.

Detection of these keeping-areas could be impeded by the common practice throughout history of collecting dung into a single heap near to dwellings (Creighton *et al.* 2007:97); but area analysis might nevertheless detect dung-containing areas devoid of occupational debris (Rissman 1989:18), or evidence of arrangements for drinking-places (Zimmermann 1999:306), and at a higher level Corona satellite imagery from the 1960s (see Chapter IX.1 on hollow ways) might pinpoint animal-route nodes, both local from ploughed fields and longer-distance.

### ***Aspects of training of animals and users***

Training of working animals (and of their handlers – see below) can be crucial to effective work output, in terms of speed and accuracy of work and also importantly in the number of handlers required (Chapter V.3). Training of animals also increases their value as an asset, though brings its own constraints: animals, especially cattle, may forget their training if not in frequent human contact and not kept separate from the herd (APP II.16). Schlichtherle (2006:172-3), describing early evidence in 4<sup>th</sup>-millennium BC Germany of cattle being stabled in villages, notes that this proximity would enable the training of animals for work. Trained animals may be less likely to stray, but as noted earlier trained cattle in particular are easier and more desirable to steal (APP II.16). As discussed in Chapter V.5, the investment, too, needs to be literally ‘sweated’ year-round, particularly if main usage is seasonal, with new uses for pack and traction animals generated by owners needing to keep their animal utilised regularly in skilled tasks, both for return on investment (APP II.31) and as noted above to keep the animal well-trained and cooperative without time-consuming re-training.

A crucial precursor to the use of working animals is the training of users, not only in handling and maintaining the animals and implements but also, for ploughing and other field tasks, in devising a revised crop strategy and agricultural schedule to make the best of the new technology; training in implement manufacture is also needed (APP II.16). The user training process in the 2<sup>nd</sup> millennium BC is clearly illustrated by the Sumerian text *Farmer's Instructions* (also known as the *Farmer's Almanac*), which describes proper cultivation of cereal crops with working animals over an agricultural year, for a farmer with some basic knowledge but in need of advice on best methods (Black *et al.* 1998-2006d, Civil 1994, Maekawa 1984).

Archaeologists tracing the spread of working animals across space and time tend to focus on the movement of the animals and associated technology, rather than of instructions for use: modern African experience indicates that it is more commonly the spread of understanding of the means of controlling animals that precipitates widespread adoption. Mutua (2004:101) reports that in Kenya

[a] recent demonstration on the use of donkeys for tillage purposes in Machakos was received with disbelief. It turned out that farmers in the area had never seen a donkey plowing. They could not believe their eyes when this was done on their own farms using a donkey borrowed from a farmer who thought it could only be used for carrying goods on its back.

Similarly I met elderly farmers in central Burkina Faso in 2013 who explained that before the 1960s they had kept cattle and were aware of pack-caravan donkeys but had had no thought of using animals for cultivation until the concept was introduced by French colonial organisations; in the south-west, farmers had commonly held back from ploughing animal adoption until young men returning from emigration brought eye-witness accounts and the funds to invest. Resettled groups and returning wage-migrants in several parts of sub-Saharan Africa are reported by regional experts at ATNESA workshops as having provided the concept and impetus for adopting animals for work (APP II.16); once implanted, new practices diffused from village to village, as with the southward spread of donkey use in regions of Africa (APP II.13 and see Chapter I.2). Starkey (1992:21) also reports that oxen were promoted for ploughing and transport in several West African countries in the 1970s-80s AD, but that the farmers became more successfully introduced to working animal adoption by their close cultural links with neighbouring regions such as Senegal, where donkeys were the established work animal. For ploughing and other agricultural work in particular, farmer-to-farmer training and

advice is widely regarded as the most effective (APP II.16). Sosovele (1994:319) comments that this may disenfranchise women as male farmers tend to teach males, while in Ethiopia Pearson *et al.* (2001:30) report that women often ask male neighbours or relatives to train their donkeys for them.

The use of donkeys by farmers is changing rapidly in many African countries. Most developments result from farmer trial-and-error and farmer-to-farmer diffusion of ideas and animals. (Starkey 1994b:1)

Enthusiasm and knowledge is best transmitted farmer to farmer; it has been shown that draft animal technology can travel quickly without government intervention, even across borders as long as there is the need and contact. (Tibbs 1989:12, on China)

There is ample evidence in Africa and elsewhere that lack of farmer training leads to low adoption or abandonment of working animals, particularly for ploughing; and similar evidence that productivity grows with experience (APP II.16). Poor or unsuitable training of farmers (as well as the animals) may well be a factor in the striking regional variations in the number of individuals accompanying the plough, as discussed in detail in Chapter V.3. Use of paired animals is of course particularly allied to use of yokes, but also to the training provided at the time of introduction (Astatke and Mohammed-Saleem 1994:304-5, Pearson and Smith 1994:123).

User training issues are exacerbated in regions without a tradition of keeping livestock, though Starkey (1981a:15, 1981b:21) and Gboku (1988:315) report from Sierra Leone that even in cultures already familiar with the animals a positive interest in using them for work – not necessarily present among traditional cattle-herders, or correlated with farmer age – is equally important. Ignorance about proper use of animals leads to reports of 'fear of cattle' (Reh 1982:77) as one of the most-mentioned factors in non-adoption (APP II.34 and Table 4 on uptake factors in Chapter V.2), and to inefficient use resulting in abandonment due to lack of work benefit (Davis 2011, Sosovele 2004:107). Daramola (1999:236) reports from Nigeria that '[c]ulturally and socially they [farmers] might find work oxen a bit difficult to handle'. In Tamil Nadu in India, Akila and Chander (2009:¶2) conclude that 'attitude of farmers towards draught animals plays an important role in the efficient utilization of bullocks in farming practices', and in Kenya unsuitable pack-donkey equipment has slowed the transfer of transportation tasks from women to donkeys (Mutua and Mwangi 2000:205-7).



Training and working with animals can therefore be a daunting prospect (Barrett *et al.* 1982:6, Farnham 1997:19), and new users might prefer ready-trained animals initially (Wood and Milimo 1994:346); as discussed in Chapter VI.2, hiring of working animals before investing in them is often a valuable process. Ethnographic studies mention specialist ox-trainers in villages (Mongomongo and Gembe 2000:183-4, Mulanda *et al.* 2000:303), perhaps implanted by the authorities; in conversations with working-animal users in Burkina Faso and Ethiopia (JG Burkina Faso 2013, JG Ethiopia 2014), new users often referred to advice being given by more experienced friends and neighbours.

In the early days of working animal use, the ox- training process was likely to have formed part of the whole cycle of breeding and supplying animals for work (see earlier). Tani (1996:405) describes the production process of draught cattle in 3<sup>rd</sup>-millennium BC Sumer, from the Lagash economic texts: 'mainly male calves were brought to the centre annually from local cattle-breeders as tribute to the temple', and these were castrated, trained for ploughing and distributed to farmers. Maekawa's (1979a:96) account from texts of the same period describes how an official looked after all cattle, then males at 1 or 2 years were given to another official who kept and trained them until 3-5 years of age, when they were supplied for ploughing. For pack donkeys, there are mentions in the 2<sup>nd</sup>-millennium BC Kaneš texts of institutions (gigamlum) which may have been breeding and training centres (Dercksen 2004:259), paralleling industrialised systems in the 19<sup>th</sup> and early 20<sup>th</sup> centuries AD in the USA and Britain, where horses were trained as part of the breeding process and supplied ready-trained to users (McShane and Tarr 2006:370, Collins 1983:86-7).

Training of donkeys for pack is generally straightforward, as tamed donkeys soon accept loads and are behaviourally suited to following in line and learning routes (APP II.3); in modern donkey-caravans the animals are generally not tied, but follow freely (APP II.22). In 3<sup>rd</sup>-millennium BC Egyptian depictions foals are often shown accompanying work donkeys, as they learn in this way from their mothers (Power 2004:136). Donkeys in modern Africa are sometimes recruited from pack-trains for ploughing, and Mutemi (2008:69), a donkey-merchant in modern Kenya, reports that donkeys found unsuitable for ploughing are resold for pack. In the Kaneš texts on pack-caravans in early 2<sup>nd</sup>-millennium BC Anatolia, Veenhof (1972:2) suggests that two types of pack-donkey recorded indicate specialist animals for heavy loads (though this interpretation is disputed by Dercksen (2004:282)).

Training for the plough includes teaching animals to walk in straight lines and recognise furrows, to turn neatly when needed, and ideally to respond to voice commands, which reduces the number of handlers needed (Figure 21).

In both Nepal and Indonesia, working animals are invariably controlled by just one person. ... In Nepal, animals are often used without nose ropes or reins..., and the basis for control is verbal commands and the tap of a stick when necessary. (Starkey and Apetofia 1986:16)



*Figure 21: Boy training cattle for ploughing, Jawi, Western Ethiopia, familiarising them with the whistled commands and lifting and lowering the ard to accustom the animals to the task (© JG Ethiopia 2014)*

McLean *et al.* (2010:20) report on studies showing that a donkey pulling a cart can be controlled simply by manipulating a 'donkey motivator' consisting of a rustling plastic bag on a stick, the sound of which motivates them to move forward or to turn.

If the animals are used in teams, there is also the task of teaching them to work together (APP II.16). 3<sup>rd</sup>- and early 2<sup>nd</sup>-millennium BC Sumerian and Akkadian texts on ploughing distinguish between different oxen in a team, probably in relation to their different type and extent of training (Potts 1997:83, Renger 1990:275); untrained oxen are assigned particular places in the plough team, and oxen trained for specific tasks such as ploughing, seeder-ploughing, threshing and non-plough draught (Renger 1990:275-6, Stol 1995:184). The 2<sup>nd</sup>-millennium BC Babylonian Code of Hammurabi specifies different rents for the various oxen in a plough team

(APP II.32) while the contemporary Sumerian 'Laws about Rented Oxen' specify significant compensation if a ploughing ox is injured (Roth 1980:127).

Donkeys are widely acknowledged in modern Africa to be easier to handle than cattle (Chapter III.1), and behaviourally more susceptible to cooperating with humans and understanding skills such as ploughing (APP II.2), though are famously stubborn if they consider the task unreasonable (Chapter III.1). The investment in training cattle for ploughing is therefore higher, particularly as they have more limited other work uses. Pingali *et al.*'s (1987:34) diagram (Figure 30 in Chapter V.4) shows the labour cost of switching from hoe to animal power, in which among the variable labour burdens of land clearing, land preparation, weeding and animal maintenance, training is shown as a fixed cost, though the draught cattle training periods reported in Africa vary from a couple of weeks or less to several months (APP II.16); the variation in training periods may reflect the level of experience of the owner, the age of the animal, the breed, or the nature of the terrain and tasks. Johannsen (2005:47) gives examples of cattle speedily trained in the 19<sup>th</sup> and 20<sup>th</sup> centuries AD (by being teamed with more experienced animals) and argues that in these cases working oxen may not be single-purpose animals kept until unable to work, but might be coopted individuals from a general beef herd, unidentifiable in the archaeological record by age of culling. Lawrence and Pearson (2002:101) report that in Asia most cattle are kept primarily for meat and milk (so in the case of females already accustomed to close human contact), and trained up for brief work seasonally. Once farmers are experienced in working animal training, they do not see training of a new animal as an obstacle (e.g. Blench 1997:51), and the practice is common in many regions of buying an ox at the start of the cultivation season, simultaneously working and fattening it, and then selling the trained animal at the end of the season and training a new one next year (APP II.19). A key issue is that of foddering the animal year-round, if plentiful grazing is not available; in time of drought working cattle may be sold to other regions (McCown *et al.* 1979:313).

A strategy recorded by Schmitz *et al.* (1991), suitable if plenty of household or other unpaid labour is freely available, is to skimp the training and only use the animals for a short period per annum, using several people to control the team (Chapter V.3). In North Africa the Tuareg rely on rough treatment to 'tame' donkeys for riding and pack (Nicolaisen 1963:109), despite widespread evidence that this is not necessary; Hagmann and Prasad (1995:235) and Waithanji (2009:19) report that donkeys in Zimbabwe and Kenya respectively are not trained but beaten to achieve

the work needed. Such strategies may be necessary where farmers lack the knowledge to train animals to a point where a single user can handle them (e.g. Haufiku *et al.* 2004:179). In central Burkina Faso (JG Burkina Faso 2013) I observed widely differing strategies concerning plough animals within a small district depending on circumstances; two young men were pushing and urging an untrained pack-donkey up and down to plough, while in contrast a few fields away a young woman (who ploughed alone as her husband worked elsewhere) had trained her donkey to respond to voice commands and to turn without prompting (Figure 22); in contrast again, a farmer in the adjoining field bought young bulls from a nearby abattoir, trained them for a few days and employed them for ploughing (requiring several family members to cajole and steer the animal) before returning them to the abattoir (Figure 23).



*Figure 22: Woman ploughing with a donkey in Ziniaré, Burkina Faso (© JG Burkina Faso 2013)*





*Figure 23: Family members ploughing with a young untrained bull in Ziniaré, Burkina Faso (© JG Burkina Faso 2013)*

### ***Harness***

The subject of harness in antiquity has been well covered by writers such as Littauer and Crouwel, with discussion of its effect on working animal adoption and performance; depictions and texts indicate use of nose-fastenings and nosebands for cattle and equids, and there is much discussion of early bit evidence (APP II.6). Use of yokes is indicated in 4<sup>th</sup>/3<sup>rd</sup>-millennia BC Mesopotamian representations and descriptions of harnessed cattle and equids, and commentators suggest that early adoption of donkeys for ploughing may have been constrained by transfer of the unsuitable yoke system (APP II.6 and Figure 24). Yokes are designed for the physiology of cattle, with their strong vertebral arch, and are unsuited to equids, which concentrate their strength in the chest (Chapter III.1). It is possible that the representations and mentions of yoked animals reflect elite practices and that other harness types were used by small-scale farmers, as with the simple traces used from early times for pulling sledges (APP II.6). In many regions today simple neckstraps or collars are effectively used, with equids trained to respond to voice and light touch; but even today donkeys are sometimes yoked, through ignorance or to save the cost of separate donkey and cattle harness (APP II.6). Modern Western discussions emphasise harness efficiency rather than expediency, but there is evidence in history and today that individuals and cultures do not always use the most effective harness despite the loss of efficiency (APP II.6).

Nobody would have understood the distinction between efficiency and inefficiency made by modern critics of ancient devices. Why did harness remain unaltered from the time the first ox-yoke was used in Sumeria c. 3500 B.C. until the introduction of breast-strap harness (invented in China c. 330 B.C.) into Europe about the sixth century A.D.? The answer is, not that ancient society was slothful, uninventive, and slave-ridden, but that the harness then in vogue was perfectly adequate and went on being so. People knew certain ways of doing necessary jobs. (Burford 1960:18)



*Figure 24: Unsuitably-harnessed donkeys, Benishangul-Gumuz region, Ethiopia (© Donkey Sanctuary 2012, by permission)*

### ***Donkey meat, hides, milk and dung***

Where the first osteological traces of domesticated donkeys are identified, at 4<sup>th</sup>-millennium BC and later sites in the Ancient Near East, the indications are that they were not generally eaten, as aside from the phenomenon of elite burials of equids (Chapter II.1) they appear to have been dumped whole, as at 3<sup>rd</sup>-millennium BC Abu Salabikh in Mesopotamia, and without cutmarks except occasionally for skinning for hides (APP II.12). In contrast, the bones of food animals are commonly found broken and scattered, with a concentration of meat-bearing bones, and show

cutmarks and evidence of cooking. Payne (1988:99-104) reports on the contrasting state of onager and donkey bones at 4<sup>th</sup>-millennium BC Tell Rubeidheh in Mesopotamia; the remains of the indigenous onagers, commonly hunted for meat (APP II.43), are fragmented and scattered, unlike those of the donkeys, which were not indigenous and constituted valuable assets. Gilbert (1991:103), referring to 2<sup>nd</sup>-millennium BC Mesopotamian horse remains, suggests that working animal carcasses may attract 'cultural meanings or functions inimical to their being used also as a protein source... A similar, although not identical, phenomenon may be seen with dogs.'

A potential early exception has been recorded at 5<sup>th</sup>- /4<sup>th</sup>-millennium BC Tell Arjoune in Syria, where equid bones (probably donkey) were found in a broken and scattered pattern (Grigson 2003:220); and a remarkable body of evidence has emerged from 3<sup>rd</sup>-millennium BC Khirbet al-Batrawy in the Jordan valley, where in contrast to other evidence to date in that region and period there is significant evidence of disarticulation, defleshing, bone-marrow removal and focus on meat-bearing parts of donkeys, as well as of skinning, with a culling profile similar to that of cattle at this site which were used for meat and work (Alhaique 2008, Alhaique 2012). This site is in a rocky region, east of the coastal plain where donkey remains (unused for food) are commonly found in settlements featuring Egyptian artefacts and which may well be domesticated pack donkeys brought up from north-eastern Africa (e.g. Milevski 2011:183). There are supporters of the theory that wild donkeys moved up into the southern Levant, perhaps from Arabia (Uerpmann 1987:30, 1989:164, 1991:12-30), along the rocky hills as well as being brought in as domesticates (Potts 2011:167, Vila 1998:144, 2006:101, Zarins 2014:33-6); a very tentative hypothesis might be that the eating of donkeys in this rocky area reflects a local history of capturing wild donkeys for food, while donkeys introduced as domesticates into the coastal plain to the west represent valuable imports, not consumed. In a later period, Michel (2014:203) reports possible faunal evidence of donkeys consumed at early 2<sup>nd</sup>-millennium BC Kaneš, where large numbers of superfluous donkeys would have accumulated from the Aššur- Kaneš caravans, obviating the practical need for taboos.

Modern analogy supports the hypothesis that the remains of non-food animals are unlikely to be found in settlements: dead donkeys may be dragged well out of camps and villages, and donkeys no longer able to work are abandoned in the bush/ desert rather than killed; donkey remains are generally absent from

settlement refuse dumps (APP II.12). Donkeys' transport work also takes them far from settlements, and when they die in harness (e.g. Dercksen 2004:261-4) their abandoned carcasses are likely to be consumed by predators. Brodie (2008:304) comments that

[t]he absence of donkey bones from domestic assemblages of what were probably food remains might say more about dietary preferences than about the use of the donkey as a work animal.

Vila (2006:103) and Zarins (2014:202) report no epigraphic evidence of donkeys being eaten in 3<sup>rd</sup>-millennium BC Mesopotamia, though donkeys are reported as possibly killed to seal the forming of an alliance, as mentioned in a text from Mari (APP II.21). In the records of Drehem, a major Mesopotamian animal redistribution management centre in the later 3<sup>rd</sup> millennium BC, donkeys are mentioned but in comparatively small numbers. This may reflect their smaller Mesopotamian population compared with the large herds of cattle, sheep and goats (Postgate 1986:198, Zarins 2014:245), but it may be significant that unlike these food animals the carcasses of dead donkeys are sometimes received (Maekawa 1979b:52-5), and that donkeys are recorded as being destined for feeding to dogs and captive lions (APP II.12); this may indicate that donkeys passing through Drehem are not destined for human food.

Scurlock (2002a:392) and Vila (1998:149) also conclude that the 3<sup>rd</sup>-millennium BC burials of donkeys in elite human graves are not related to food offerings, though Way (2010:211-15) leaves the question open on later examples in the southern Levant. In ancient Egypt there is occasional mention of donkey meat, and parts of donkeys are recorded as being used medicinally, but the meat then appears to become taboo, perhaps by reason of the donkey's association with the god Set (Bulliet 2005:150, Osborn and Osbornová 1998:136); Marshall (2007:384), though, suggests that the burnt donkey remains at 3<sup>rd</sup>-millennium BC Maadi might relate to use as food.

In modern Africa there are indications that Gilbert's (1991:103) hypothesis above on cultural taboos on eating working equids still applies to domesticated donkeys in many situations outside emergencies. In a large body of overviews of donkey use by regional experts and findings from specific studies initiated by government organisations, published in academic journals and official aid organisation documents, the eating of donkey-meat even in regions of major use is confirmed as



comparatively rare and largely confined to specific minority groups (APP II.12). Traditionally in these groups there is low-scale eating of culled and aged donkeys, with only occasional instances of deliberate fattening of donkeys for eating (Blench 2000:343, Epstein 1984:178), though the eating of donkeys in Africa is probably more widespread than is commonly reported, and is increasing in some areas. A movement of (older) donkeys between non-eating and eating groups, as from Muslim to Christian and animist areas (William Clarence-Smith pers. comm. 2016), may be archaeozoologically-detectable.

Donkey meat is tough and the flavour is disliked by some, so is often found smoked or processed into salami (APP II.12). Outside Africa, donkey-meat is reported as eaten in 2<sup>nd</sup>-millennium BC Greece (Paul Halstead pers. comm. 2017), in Greco-Roman times (Bodson 1985:6) and in modern Athens, Hungary and France (Audiot and Garnier 1995:66, Epstein 1984:178), as well as increasingly in China (Crane 2011:2). Taboos may be born of practicalities – the donkey is long-lived, and there is no economic sense in killing a trained, experienced animal while it is still useful (Jones 2008a:6, Smith and Pearson 2005:1). Lattimore (1928:144) notes the different behavioural codes relating to camels in Mongolia, between cameleers who had strong taboos about killing their working camels (though will eat wild ones), and traders who freely ate camels. Similarly, Native Americans with small numbers of horses were generally reluctant to eat their working animals while those owning large horse-herds and with a less close working relationship would eat horses (Ewers 1955:222, Gilbert 1991:103, Härmäläinen 2008:240, Lawrence 1985:8). In Africa, Marshall and Weissbrod (2009:71) report Kenyan Maasai pastoralists' objection to eating animals who work for them (though add that such taboos are sometimes broken in secret at times of drought); the neighbouring Kikuyu have less close working relationships with donkeys, and do eat donkeys. Twerda *et al.* (1997:51-2) contrast the Samburu, who 'regarded it as being inferior to consume donkey products other than for medicinal reasons', with the neighbouring Turkana, who eat donkey-meat and are seen as 'a hardy society used to surviving in harsh conditions where every possible source of food must be used': here, in contrast to the Native American example, equids are consumed by the poorer group.

Taboos may overtly relate to religion; in present-day developing regions donkeys are commonly not eaten in Hindu, Buddhist, Islam, Jewish and some Christian societies, while the Confucian religion does not ban their consumption (Blench 2004:24, Bulliet 2005:150, William Clarence-Smith pers. comm. 2016). There are

nuances in this analysis, with Muslims seemingly forbidden to eat domesticated donkeys but not wild ones, and the pattern of modern donkey-eating generally features criss-crossing of religious, cultural and lifestyle factors. Blench *et al.* (2004:213) suggest that outside the donkey's native habitat 'the donkey is an exotic to which no culinary taboos attach', but there seems an economic objection to this hypothesis. Taboos may vary in strength – Leach (1964:31) notes the difference between a species recognised as food but prohibited, and those not recognised as suitable for food at all. Such taboos may make donkeys less attractive to thieves than cattle (APP II.2) but can lessen the perceived desirability of donkeys over working cattle as donkeys are not useful for subsequent selling for meat (APP II.12).

Donkey hides are tough and elastic so have a range of uses including for parchment, but unlike cattle-hides they are not widely used in modern Africa (APP II.12), perhaps because 'the prejudice against the flesh of these animals has been extended to these products' (Simoons 1960:147), though donkey tail-hair is sometimes used and there is an increasing export trade in hides to China for use in medicine and cosmetics (Yusuf *et al.* 2016). The wild onagers indigenous to the Near East may well have been hunted for hides as well as meat from an early date (APP II.43 and as argued by Kirkbride (1974:85) at Umm Dabaghiyah), and Zeder (1986:404) has suggested that donkeys may have been among the equids butchered for hides at 3<sup>rd</sup>-millennium BC Tal-e Malyan in SW Iran, from the equid bone distribution, with the head and limbs removed and the remaining carcass taken elsewhere. There is Ancient Near Eastern textual evidence of skinning for hides in the 3<sup>rd</sup> millennium BC (Vila 2006:108, Zarins 2014:220), and at 3<sup>rd</sup>-millennium BC Khirbet al-Batraway and 2<sup>nd</sup>-millennium BC Tell Jemmeh donkey remains show some cutmarks indicating skinning for hide (Alhaique 2008:340, Alhaique 2012:346/349/360, Wapnish 1997:343). Overall, though, there are few archaeological indications that domesticated donkey hides (and sinews etc) were systematically harvested, perhaps because the supply of dead animals was not centralised. Clutton-Brock (1986:209) reports for example that the domesticated donkey carcass in the ash-tip at 3<sup>rd</sup> millennium BC Abu Salabikh in Iraq had been deposited complete with hide.

Donkey milk is high in lactose and very close in composition to that of human milk (APP II.27); it was used for human babies in 19<sup>th</sup>/20<sup>th</sup>-century AD France, and mentioned occasionally in ancient Egyptian texts, though not in Mesopotamian ones (Zarins 2014:22). Donkeys rarely produce excess milk, and in Africa the milking of

donkeys is not widespread, because the milk is often seen as 'unclean' but also probably due to low-management systems in which milking would require regular catching of the animals; other more productive animals such as goats are, too, more readily available. Milking of donkeys (and use of blood from live animals including donkeys) is practiced by a few pastoralist groups such as the Maasai and Turkana; donkey-milk is also consumed in Mongolia and China, but its use elsewhere in the modern world is rare. Donkey milk is considered in some modern African and Chinese cultures to have medicinal and magical qualities (Yusuf *et al.* 2016), and in Greco-Roman times it was recommended for cases of poisoning and snakebite, various illnesses and aches, healing of wounds, etc, as well as being used for cheese by the Phrygians (Bodson 1985:6) – though it is low in fat and protein so not easy to turn into cheese. In Jane Austen's unfinished novel *Sanditon*, Lady Denham mentions several times her eagerness to sell her donkey mares' milk to lodgers, saying that her potential lodgers 'may be consumptive and want asses' milk; and I have two milch asses at this present time' (Austen [1817] 1978:40). Donkey milk is also used in some African and Western cultures for cosmetic purposes (APP II.27).

The use and virtues of dung is a large and growing subject, but outside the scope of this thesis. In the 20<sup>th</sup> century AD there were various unsuccessful drives by authorities in Africa and elsewhere to encourage farmers to cultivate in a new mode, using manure from working animals rather than the traditional shifting or fallow systems (see Chapters I.2 and V.5). Key in the failure of the model was the consequent distancing between animal-keepers and agriculturalists, as there were no longer opportunities for pastoralists to graze their animals on resting land (APP II.40 and Chapter VIII.4). Dung collection from working animals can nevertheless add to their profitability, providing fertiliser, fuel and construction material, and donkey-dung is recorded as having been used in Greco-Roman times (Bodson 1985:6). Donkey-manure is fibrous, which may have been valuable in use as temper for manufacture of pottery (Darnell 2013:224), whereas the more plastic cattle dung is preferred for construction tasks (Moreno-García and Pimenta 2011:21). Views on its value as fertiliser vary (APP II.27); it can be easier to collect than cattle-dung as donkeys tend to defecate in designated places, and their dung is drier and so does not disappear into the ground so quickly (APP II.27).

### IV.3 Implications for early use of working animals

The 'shift of focus from the dead to the living animal' (Meadow 1984:310) results in some very different economics. Little recognition has been given to date to the economic and social impact of the range of new activities consequent on the systematic use of working animals, and promotion of this aspect forms a key element of my research aims. In the modern industrialised world there has been rapid forgetting, for example, of the complex nature and central importance until very recent times of working-equid breeding and trading.

A range of texts from the 3<sup>rd</sup> millennium BC (recounted notably by Zarins 2014 and Sallaberger 2014) offer striking Mesopotamian parallels with modern sub-Saharan African systems of donkey supply. The evidence from both antiquity and modern analogy is that large-scale breeding of donkeys for work, from the time of their early systematic use in Mesopotamia, has been conducted by specialists and located in remote, arid regions suited to the animals' natural habitat. The transfer of animals to areas of demand, from early times to the present day, has arguably always been conducted through chains of regional livestock accumulation centres and markets which form a crucial interaction point between mobile groups, who in turn have productive contact with sedentary cultures. A different trajectory is seen in the breeding of cattle: although again they are commonly bred in suitable regions and conveyed via markets to areas of high demand (textual accounts of 3<sup>rd</sup>- and early 2<sup>nd</sup>-millennium BC cattle-supply centres are recorded by Heimpel 1995 and Stol 1995), their production may relate to maximisation of meat and milk potential rather than work capacity.

Donkeys require little herding as they tend not to stray and are adept at locating their own food and at defending themselves against predators. In contrast, working cattle generally require active herding – and so more labour use – as they need regular access to good grazing and to water. Theft of valuable working animals (as noted of cattle in 3<sup>rd</sup>-millennium BC texts) is also a factor in their herding and sometimes corralling; archaeological detection of corrals and pens is problematic but is advancing through methods such as analysis of dung presence.

While training of donkeys for pack and ploughing is generally reported to be straightforward, full training of cattle for traction can be time-consuming, as recorded in detail in 3<sup>rd</sup>- and early 2<sup>nd</sup>-millennium BC texts. Payback is required in year-round

use, for in-house transport work or as a financial and social asset for hiring out or lending. Choices in the extent of training of ploughing cattle, from *ad hoc* recruitment to several months of induction, may reflect availability of farm labour, as there is a direct effect on the number of handlers required; good training of users is also a key factor in the latter. Training of female cattle for work may be comparatively easy as dairy cows are accustomed to handling. Female cattle are widely employed for ploughing and other work in many regions today, as described in Chapter III.2, but their use in antiquity – and the use of uncastrated bulls – may be underestimated archaeologically, not least as some models of ploughing animal use rely on evidence of castration of bulls.

A notable feature of donkey-use from prehistory to the present day, contrasting with practices concerning cattle, is the low incidence of their consumption or even use of hides, as in accounts of the 3<sup>rd</sup>-millennium BC animal accumulation and supply centre Drehem. Donkeys in ancient Egypt became associated with the 'evil' god Set, and taboos on their consumption may relate to the low esteem in which they are widely held from ancient times onwards. The rarity of donkey remains (aside from elite burials, as noted in Chapter II.1) has militated strongly against their inclusion in archaeological models of working animals in antiquity, as detection of animal presence is habitually done through analysis of food-middens and other settlement evidence, while donkeys to this day die on the road or are taken out of settlements to die or once dead so comparatively rarely appear in the archaeological record. They might usefully be regarded in the same light as organic materials – known to be present only by their impact on archaeologically-detectable factors.

## V RETHINKING ANIMAL PLOUGHING

### V.1 Ard ploughing

The earliest plough type was the ard, a simple wooden implement with a pointed pole attached to a draw-bar hitched to the animals' harness; it disturbs a line of soil while leaving the surface intact between the rows (McCann 1995:45, Potts 1997:73-5, Renger 1990:273/277; see Figure 25). Cross-ploughing is employed if further breaking up of the soil is needed (Figure 26). A refinement, as described in the mid-2<sup>nd</sup> millennium BC *Farmer's Instructions* text (Black *et al.* 1998-2006d:¶46-54, Civil 1994:83) and shown on a contemporary seal (Figure 27), is a seeder attachment. The maresha plough widely used in Ethiopia today is of the ard type (Figure 28), often home-made from branches and sometimes without use of metal (APP II.31) – though some Mesopotamian ards may indeed have been bronze-tipped (Brewer 2004:19). Although the implement is simple, it can be used in a sophisticated manner to suit crops and terrain (McCann 1995:51); a similar implement was used up to the 19<sup>th</sup> century AD in Iran (Floor 2003:208), and in recent Greece and Spain (Halstead 2014:35) for covering sown seed.

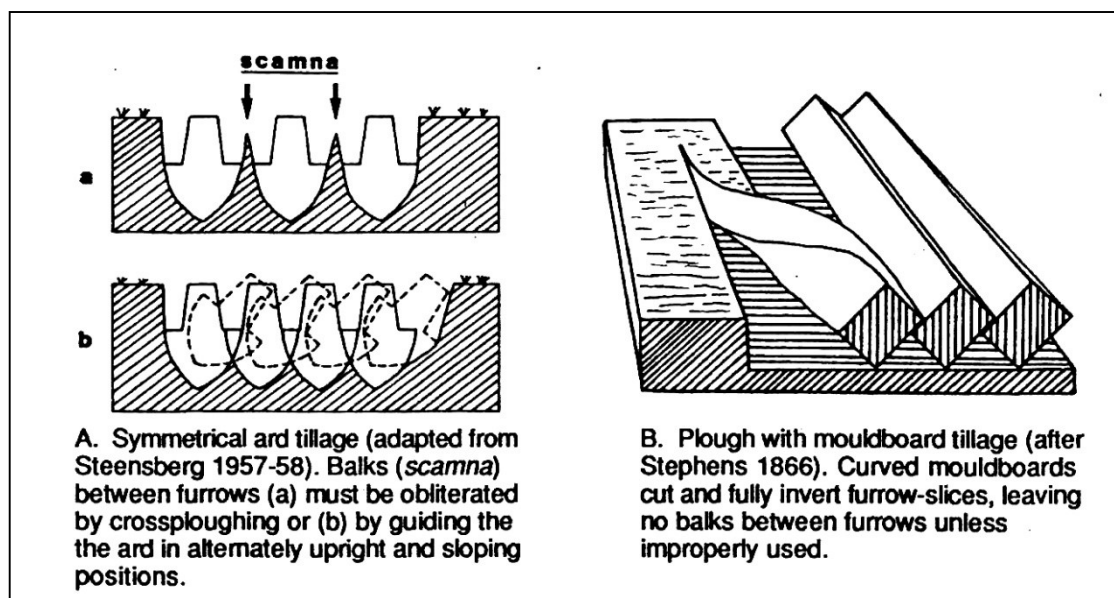


Figure 25: Ard and mouldboard actions compared (Russell 1988:121, © BAR Publishing, by permission)

The ard can be pulled by human power, and in times of need is so used in some regions to the present day (e.g. Fisher 1990:32, Hole 1978:148), though in practice reversion to manual cultivation is generally likely to be more practical. Sherratt

(1987:4) argues against this use in antiquity; it is suggested briefly by Drenth and Lanting (1997:63) as an explanation for narrow early ard-marks, though the authors agree that it would be hard to verify.

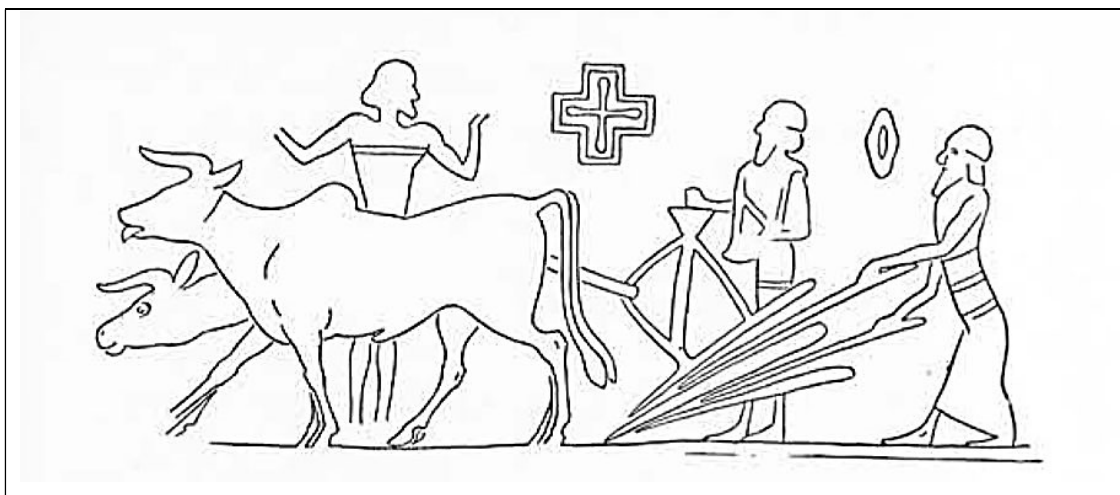


*Figure 26: Cross-ploughing with yoked donkeys and a maresha plough in Jawi, Ethiopia (© JG Ethiopia 2014)*

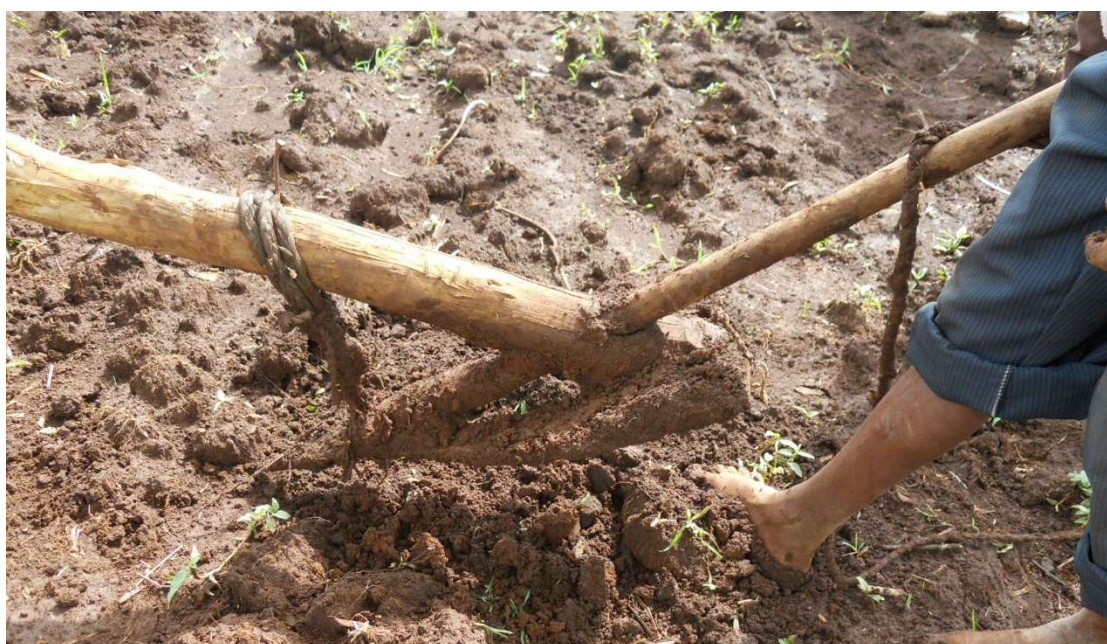
The power supplied by animal traction can translate into greater ploughing depth than manual cultivation, but commentators on early animal traction risk falling into the trap of conflating deep ploughing and mouldboard ploughing. Mouldboard ploughs have a flange to invert the soil (see Figure 25 above), requiring significant force; they were evolved to process effectively the damp, heavy soils of European temperate zones (Henriksson and Lindholm 2000:12, Stevens 1994:169), burying weeds and pests too deep to survive (Brigden 1984:3). A range of on-farm studies in Africa and elsewhere, conducted by government agencies looking to provide suitable technology to regions, demonstrate that in light, dry soils this inversion instead causes soil compaction, erosion and nutrient depletion (APP II.31); and indeed ard-ploughing with powerful animals can risk similar drawbacks (Brodie 2008:303, Potts 1997:73). As I note in my research aims, light soils may need little working (APP II.31); Oates and Oates (1976:119) note that ard ploughing is still used in modern Mesopotamia to avoid over-cultivation, and overviews by agricultural experts report moves away from soil-inversion ploughing in some regions of sub-Saharan Africa and towards 'minimum tillage' systems (e.g. Chelemu and Nindi 1999:113, Siacinji-Musiwa 1999:30), using a ripper or a simple tined point



similar to an ard. Kjaerby (1983:38) reports that in parts of Tanzania rules were introduced banning ploughing altogether in light soils due to erosion problems.



*Figure 27: Illustration of a seeder-plough from a mid-2<sup>nd</sup> millennium BC Kassite cylinder sealing (courtesy of the Penn Museum, image no. 6899)*



*Figure 28: Maresha ard plough, Jawi, Ethiopia (© JG Ethiopia 2014)*

Direct comparisons of animal ploughing performance with manual cultivation are complex and often inconclusive, and comparisons using mouldboard ploughs are invalid for consideration of performance in antiquity. Animal traction and manual cultivation are, too, often complementary rather than alternatives. While day-to-day 'exchange' rates are employed, such as the common Ethiopian equivalence calculation of one ox-team day to 4-5 human labour days (McCann 1984:4), farmers



adjust their individual calculations to account for the many other factors. Variables in ground coverage, yield and economics include technique (seeding/ broadcasting), equipment and animal investment including depreciation and maintenance, number/ species/ condition/ harness of the animals used, comparative manpower (including guiding the plough-team and dealing with animal husbandry), hours per day worked, other field tasks such as weeding, and terrain, altitude, climate, soil, presence of animal disease, feeding and watering, other utilisation of the animals (APP II.31); Figure 13 in Chapter III.1 illustrates the myriad elements.

## V.2 Uptake factors

Table 4 below summarises in very broad terms the key factors put forward by commentators in more than 100 studies and overviews as affecting uptake of working animals for ploughing, by farmers formerly using manual cultivation. The sources are largely though not wholly from modern (often sub-Saharan African) studies, and can only be taken as a general indication of possible considerations in antiquity as there may be influence from modern elements such as mechanised means and official/ NGO intervention (though the latter is of course not only a modern phenomenon). The factors are listed in very approximate descending order of frequency of mention in studies of animal ploughing, as a rough guide to their influence in adoption.

Table 4: Ploughing uptake factors

<b>Factor (approx. descending order of mention)</b>	<b>Notes</b>
<b>Cultural/ religious barriers</b>	Including taboos for women handling animals, herders not wishing to plough
<b>Labour</b>	Availability of supporting labour, including for animal maintenance; use of children. Calculations hinge on the cost of labour – difficult to compare ancient and modern
<b>Entry cost/ return on investment</b>	Initial step, cash flow, means of obtaining a return
<b>Unfamiliarity with/ fear of animals</b>	Including the crop/ animal divide
<b>Availability of suitable animals</b>	Presence of cattle, donkeys
<b>Type of animal introduced</b>	e.g. cattle introduced where donkeys more suitable
<b>Authorities/ support</b>	Official promotion, assistance, vetos
<b>Disease</b>	Tsetse-fly regions in Africa, parasites
<b>Training of farmers</b>	Including learning from neighbouring groups
<b>Market for surplus</b>	As driver or need
<b>Availability of land</b>	Land spare, or not available/ need to adopt advanced agriculture
<b>Climate</b>	Suitability for animals
<b>Soil type</b>	Heavy ploughing is less suitable for sandy soil
<b>Year-round utilisation</b>	Hiring/ sharing/ lending, use for transport
<b>Training of animals</b>	Crucial to cost-effective ploughing

<b>Access to grazing/ fodder</b>	Crucial for cattle in particular
<b>Animal maintenance</b>	Labour issues
<b>Prestige cattle</b>	Cattle kept for status
<b>Terrain</b>	
<b>Crop type</b>	Cash, subsistence
<b>Size of household</b>	Large household might be a driver
<b>Link with transport</b>	Animals to transport crops/ implements to/ from fields; ancillary farm transport; year-round use
<b>Length of season</b>	
<b>New farming systems needed</b>	Changed annual cycle, e.g. sowing, weeding; need for destumping fields
<b>Meat value</b>	Cattle have residual value
<b>Harness/ equipment</b>	Knowledge, suitability
<b>Theft of animals</b>	Also predators
<b>Social relations</b>	Users/ non-users; communal vs family tasks
<b>Issues for early adopters</b>	Also characteristics of early adopters
<b>Manure</b>	New need, for productivity; availability from working animals
<b>Reduced burden</b>	Eases tasks for household members – or not
<b>Size of farm</b>	Large- and small-scale farmers have different strategies
<b>Economic strategies</b>	e.g. Buying/ training/ selling of working animals

A key finding in this examination of the adoption and impact of working animals is the complex interplay of factors, and the failings of single-issue arguments. Ngamau (1999:80), a female farmer in Kenya, underlines the point that

[a]ny new or improved technology targeting the farmer must be approached from a holistic point of view and the farmer must be a participant all the way from the initial thought. Whatever is being introduced or improved must fit into the existing links that make the chain of activities which form the whole existence of the farmer.

Full comparative analyses of the many factors in ploughing adoption decisions would merit a thesis in themselves and involve much agronomic detail. APP II.31 lists some key commentators on the multiple factors affecting uptake of working animals for ploughing in Africa and elsewhere. Meanwhile, the paragraphs below address some factors where modern analogy may be of active help in appreciating

the options and choices and their potential impact in antiquity. Other elements are covered more fully in other chapters.

## V.3 Plough team

### *Number of animals in the plough team*

In present-day regions using ard-style rather than mouldboard ploughs there are notable cultural variations – beyond factors such as lightness of soil – as to whether a single ploughing animal or a pair (or more) is used, perhaps dating back to the original harness type and farmer training process introduced locally. A single animal is better-adapted for lighter farm tasks such as weeding, and easier to handle (e.g. Barrett *et al.* 1982:15/25), but is likely to need feeding more, to fuel its work (Jabbar 1993:264, Starkey 1989:36). Sherratt (2006:331/344) discusses the two-animal pole/ yoke system appearing in European and Near Eastern depictions from the 4<sup>th</sup> millennium BC (APP II.6/32), contrasting it with the single-animal trace-harness arrangement apparently (*pace* Littauer and Crouwel 1979:11/14) used for some contemporary sledges in the latter region, and suggesting (p351) that different practices in antiquity stemmed from cultural choices or other circumstances rather than to separate diffusion of discrete systems. Stol (1995:189) considers from Old Babylonian textual evidence that ‘ploughs with more than two oxen were primarily used on the large estates of “public” institutions’, so perhaps relegating trace harnesses as perhaps more suitable for single- or dual-animal use on smaller farms. Both donkeys and cattle (male and female) are referred to in Girsu and Umma texts as carrying out similar tasks, though species are normally not mixed, or only as a temporary expedient (Heimpel 1995:91-3/134).

In Neolithic Crete, particular pathologies have been found in cattle indicating that – as commonly throughout history – each animal in a pair was habitually used only on the left or the right (Isaakidou 2008:105), deepening the investment burden as spare animals cannot easily be switched in. References in late 3<sup>rd</sup>-millennium BC Girsu texts and the early 2<sup>nd</sup>-millennium BC Code of Hammurabi also refer to oxen specially assigned to a place in the team (APP II.32). Up to eight animals in a team are mentioned in texts from the same sources (APP II.32), but there are indications that some may be trainee or reserve animals (APP II.32); or as in some regions today, animals may be rotated and changed when tired (JG Burkina Faso 2013, Stol 1995:190). This is also a large number to feed and care for: Heimpel (1995:97) notes that in late 3<sup>rd</sup>-millennium BC Girsu texts cultivators received extra barley for young animals, perhaps to compensate for supporting non-working animals.

Littauer ([1983] 2002:8) comments that Near Eastern soils do not need the power of two oxen; one animal is commonly used in some regions of sub-Saharan Africa with light soils, for full ploughing (Betker and Kutzbach 1991:223, JG Burkina Faso 2013) or even in pair-oriented Ethiopia for planting (Astatke and Mohammed-Saleem 1994:302). McCann (1995:78-80) describes the elaborate systems evolved in Ethiopia to assemble a pair of oxen by farmers only owning one, and the impact:

[t]he issue of oxen ownership versus rental, sharing, or borrowing appears to be a major determinant of economic class within the ox-plow system.  
(McCann 1995:80)

Using multiple animals requires particular training (APP II.16) and more elaborate harness, and reduces the pulling advantage (and sometimes speed) per animal, but can of course deliver more absolute power and allow working for longer (APP II.28). Paired animals may plough a straighter furrow (Littauer [1983] 2002:8, Sherratt 2006:342) though (particularly if cattle) trample a wider area and need more turning space; the investment is higher, and more ploughing personnel may be needed (see below), though in Ethiopia and many Asian countries paired animals are guided by a single person (Blench 1997:30). The differences in performance and personnel often rest on quality of training, of the animals and the people (Chapter IV.2), and of good feeding of the animals (Chapter VI.1).

### ***Number of people in the plough team***

Late 3<sup>rd</sup>-millennium BC Girsu texts describe three humans managing the plough team: one at the front for turning the team and two at the back, comprising the ploughman and another (Maekawa 1984:82), as also shown in a well-known 2<sup>nd</sup>-millennium BC seal impression (see Figure 27 above). The early 2<sup>nd</sup>-millennium BC Sumerian poem *The Debate Between the Hoe and the Plough* and other contemporary texts report a six-oxen plough-team as controlled by four men (Black *et al.* 1998-2006a:¶80-90, Stol 1995:191, Vanstiphout 1984:244); the Code of Hammurabi (§257-8) and 2<sup>nd</sup>-millennium BC texts from Mari and elsewhere indicate the plough-man at the back to be higher-status (though still lowly) than the ox-driver, who is sometimes female or a child (Stol 1995:188/192-3/207-8).

In much of modern Africa two or three people are also commonly used, with a plougher, a leader, and an assistant (often a child or woman) with a switch to drive the pair of animals (see Figure 23); but in countries with a longer tradition of draught

animal use such as Ethiopia and Asia, the team are controlled by a single person, using voice and the touch of a whip (APP II.31). Renger (1990:271) takes the view that the additional individuals are employed because ploughing then becomes more accurate and efficient. Certainly it can be useful to have an individual at the head of the oxen to turn them at the end of the furrow, but Starkey comments that

[s]uch excessive use of labour may even be counterproductive, for experience... shows that oxen walk in straighter lines and achieve better ploughing if they are controlled from behind with reins. (Starkey 1981a:13)

Paul Starkey adds (pers. comm. 2015) that in Guinea-Bissau several men are sometimes used to control and drive a two-oxen plough team in order to demonstrate to the village how wild and difficult the animals are, to lessen the chance of their being stolen; and Bwalya and Akombela (1999:83) report how in Zambia 'Draft animals are regarded traditionally as wild animals which should be approached by men who seem to be stronger than women'. There may too be a subtext here echoing the prestige element evident in the ancient texts and depictions (see Figure 29), where men are publicly seen to be controlling fearsome animals.



*Figure 29: Uruk-period seal showing two men controlling a ploughing bull (© Trustees of the British Museum 2015, by permission)*

A likely factor in the number needed is the level of training of both the animal and of farmers unused to close contact with draught animals (Blench 1997:30, Haufiku *et*

*al.* 2004:179, Schmitz *et al.* 1991:78) (Chapter IV.2). Another factor may be indicated in the Disputation poem, which mentions the frequent breaking-down of the plough and the need for manpower to right it (Black *et al.* 1998-2006a:¶¶91-103).



## V.4 Labour, yield and area ploughed

Area ploughed, yield and labour use form a triangular calculation in which individual circumstances and motivations, as well as knowledge and training, strongly influence decisions. Halstead (1987a:85, 2014:37-9) reports that traditional farmers in the modern Aegean, their strategic farming viability proven, are often totally unable to give yield or labour figures in forms useful to agronomists. If examined in economic detail, the labour advantages of adopting ox ploughing are not always immediately obvious – a matter underlined in my research aims. Pingali *et al.* (1987:106) note from a detailed survey of African models that '[t]here is widespread disagreement... as to whether the total labor requirement per hectare declines when the plow is used.' Analysis of more than 20 published sources on this subject in modern situations – including large-scale surveys of animal-ploughing in West Africa and papers by regional agricultural and animal-traction authorities on East Africa, sub-Saharan Africa generally and Iran and China – displays a very wide spectrum of findings on the present-day relationship of yield to labour unit (APP II.31), with area expansion often not matched by yield increase per labour unit (APP II.1), but rather by yield increase per farm. The key benefit of animal ploughing is likely to be speed of working, which can allow a greater area to be ploughed per season than with the hoe; APP II.1 notes sources discussing this process, mainly relating to sub-Saharan Africa. The factor of hectarage in ploughing-animal adoption is a contested subject, notably in terms of causation; Goody (1976:107-8) and Halstead (1995:13/16) are among many commentators (APP II.1) reporting that ploughing not only enables but requires greater hectarage cultivated in order to justify the investment in ploughing cattle, though this argument does not take account of other factors such as other uses of the animals or of the lower investment costs associated with ploughing donkeys (see Chapter III.1). In modern Africa the conclusion from multiple studies and overviews is that the driver for animal-ploughing on large farms is likely to be that of further exploiting available labour resources for yield increase (APP II.1), while on small farms a pivotal factor is the extent to which the animals can be used for other purposes. On small farms there is typically a frugality of working-animal use (see below on year-round utilisation), with ploughing quite often a minor activity: ploughing donkeys are mainly used year-round for transport (Chapter VII.1), oxen mainly raised for meat plus some draught activity, and cows mainly used for milk and calves. This is an element of the 'total factor productivity' measurement proposed by Carswell (1997:4), in

which non-farm activities such as income-earning or hunting/ fishing have a significant influence on farm-related capabilities and decisions.

A particular drawback of increased hectarage is the increased burden of manual labour for ancillary work – or perhaps not, as with small-scale farmers who prefer low yields to hiring labour for weeding (e.g. de Wilde 1967:77 and Kjaerby 1983:55 on sub-Saharan Africa). Certainly archaeological commentators have picked up the concept of the ‘harvest bottleneck’ – the concentrated labour requirement at harvest-time arising from greater yield per farm from whatever cause – from writers such as Brodie (2008:303), Delgado and McIntire (1992:189) and Halstead (1995:14/17, Halstead and Jones 1989:48), perhaps as it is an easily-visible labour-user up to today; modern example, though, reminds us that there is a danger of double-counting of labour, as craft specialists such as potters and implement-makers may spend the harvest season working in the fields (Philip 2001:187, Spencer and Byerlee 1976:878). Weeding is also emphasised in modern African agriculture as a major bottleneck, sometimes beyond even that of harvesting; weed growth, if not checked by continual weeding by hand or animal-drawn weeders, reduces yield significantly. In modern Africa, single animals – preferably donkeys – are used for pulling weeders (including ards used for this purpose), though in Sumer the transition from manual to animal-powered weeding may not have been made: in the early 2<sup>nd</sup>-millennium BC *The Debate Between the Hoe and the Plough*, the Plough describes the Hoe as ‘weeding miserably with your teeth’ (Black *et al.* 1998-2006a:¶52-6). Ploughing is even said to encourage more weeds, from ground disturbance and from wider spacing of crops, and there is an alternative argument that some weed presence is beneficial, for shade and soil aeration, and that over-working of the soil for weeding leads to desiccation (APP II.33). Comparison and conclusions are further muddled by the factors of fallowing and of broadcasting versus row-planting.

The clearest finding from a range of African and other published sources is that labour is shifted rather than reduced: aside from weeding and harvesting, new labour tasks are created as animals require harnessing, training and maintenance (Chapter IV.2) as well as the feeding and watering of animals unable to graze in daytime and requiring extra nutrition for work (Chapter VI.1). Delgado and McIntire encapsulate this in their report on surveys in West Africa of factors in ox-traction adoption, concluding that

[o]x-driven technology in the Sahel may be more labor shifting than labor saving. Linear programming models indicate a prohibitive opportunity cost of extra labor required for team maintenance and use on small, rainfed farms growing traditional millets and sorghums in Upper Volta [modern Burkina Faso]. Farm simulations suggest that ox plowing increases cash crop acreage, but clearly profitable adoption requires companion innovations to boost labor productivity in peak periods. (Delgado and McIntire 1982:188)

[t]he main effect of larger farm size is to shift the labor problem from the opportunity cost of team maintenance to the new labor requirements for expanded crop cultivation. (Delgado and McIntire 1982:192)

The labour impact of these new tasks is recognised in early 2<sup>nd</sup>-millennium BC texts from Mari and elsewhere which indicate 'plough teams' of up to 16 individual humans but specify that some of the team members are working on harvesting, threshing, milling, reed-cutting and irrigation rather than following the plough (Stol 1995:192-5). In the slightly later *Debate Between the Hoe and the Plough* cited above, the entourage surrounding the plough work extensively on land preparation, weeding and destumping (Black *et al.* 1998-2006a:¶¶80-90), harness-making and implement-repair (¶¶91-103); foddering must have been another major occupation for the teams.

Figure 30 below indicates typical labour-cost trajectories in modern Africa and the 'switch point' for animal ploughing. An issue commonly discussed in relation to African animal traction but rarely mentioned by archaeologists is the need in some cases to clear land of stumps, roots and stones before animal ploughing is employed (APP II.1). The benefits of animal ploughing are also strongly contingent on a range of factors such as crop type (APP II.31) and length of growing season. Ploughing may prevail over manual cultivation for a short planting/ growing season (Barrett *et al.* 1982:6, Isaakidou 2011:107, Tibbs 1989:10), though a longer season allows more utilisation of the animals (Blench 1997:23, Jaeger and Matlon 1990:37), including the important economic factor of hiring out to other farmers (see Chapter VI.2).

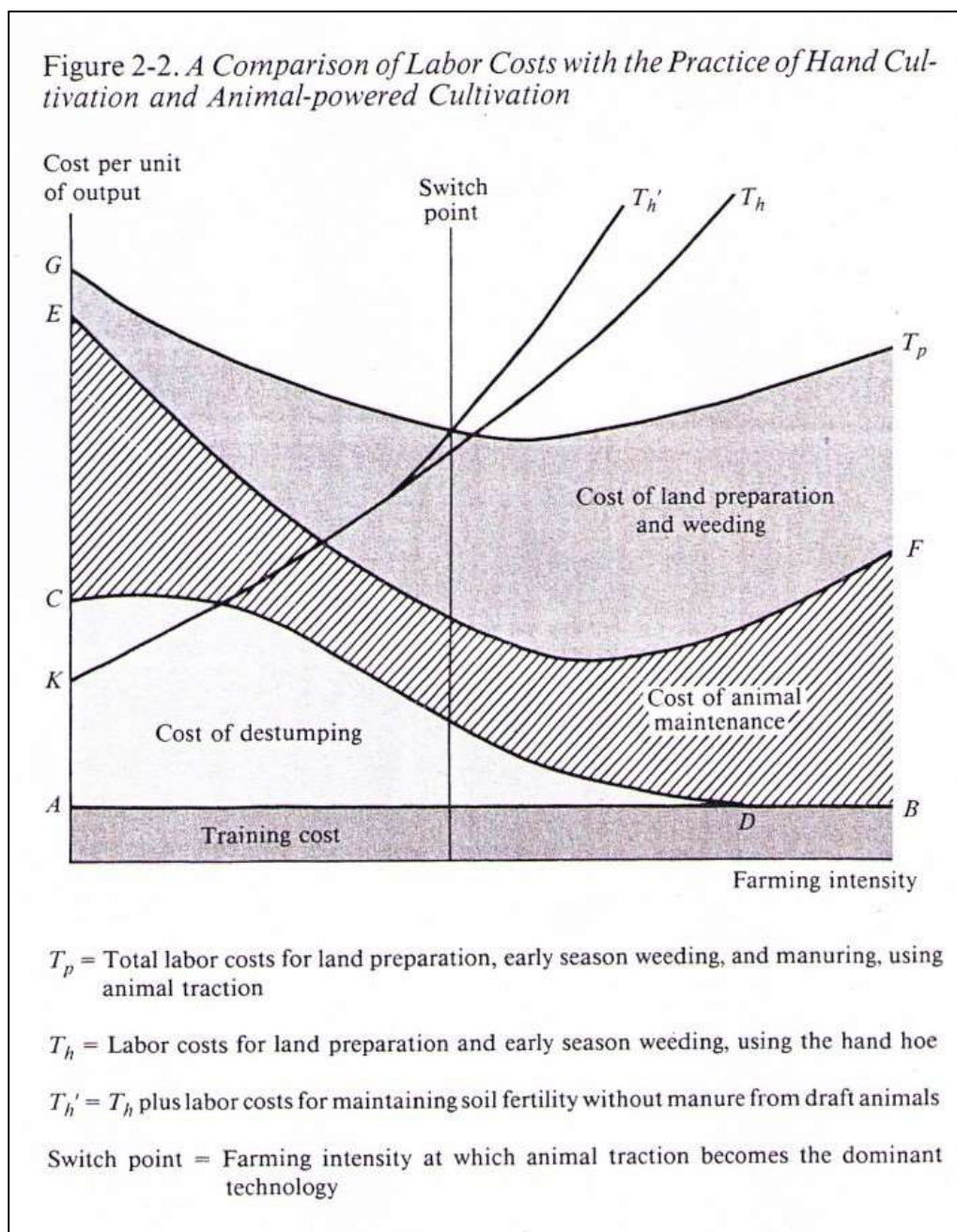


Figure 30: Graph of the switch point for labour cost advantage (Pingali et al. 1987:34, by permission of Prabhu Pingali 2017)

Concerning crops, the centrally-controlled sector of the agriculture of 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamia (as distinct from the household-level farming discussed in Chapter II.1) was likely to have focused on barley and wheat, with a few minor cereals, oilplants and probably millet (APP II.32). As might be expected, cash crops were and are now plough-oriented (APP II.31), so featuring cereals rather than root crops and perennials, and rationalisation of sowing times (Tibbs 1989:10); a factor in the adoption and success of ploughing came to depend upon access to markets for these (Jaeger and Matlon 1990:37, Langha 1999:239, Pingali

*et al.* 1987:4). The impact of such changes on economics and society are illustrated by McCann's description of the adoption of the plough more than two millennia ago in Ethiopia:

[t]he conversion of horticultural societies, pastoralists and agrarian systems, which were based on perennial crops, to the ox-plow complex based on annual crops and integrated livestock management, implied more than a simple change of economic base or political authority. The use of the plow meant a transformation in environmental management: a livestock system which produced, trained, and maintained a stable supply of oxen, a reorganization of seasonal labor to fit a new set of crops, and a resource tenure system in which fixed multiannual resources – perennial crops – lost pride of place to annual crop fields. (McCann 1995:70)

Labour cost and availability in the ancient world are problematic constructs for consideration, particularly where encumbered labour is involved. In Sierra Leone, in a rare modern example, ox-plough technology was introduced for subsistence crops by the colonial authorities in the mid-20<sup>th</sup> century AD when their banning of the domestic slavery of the Limba tribe by the Mandingo led to a shortage of agricultural labour (Gboku 1988:312, Kanu 1988:277, Starkey 2000a:489). Sherratt (1997a:34) suggests that availability of working animals will lead to reduction in slave use, but for centralised farming of the type recorded in Mesopotamia a source of landless labourers is required (APP II.32). Foster (1977:37) argues concerning Sargonic Mesopotamia that although 'chattel slaves were not a significant productive labour force in third-millennium Mesopotamia, it is clear they were a luxury for which there was a ready market.' Halstead (2014:121) suggests that where harvest windows are narrow 'the maintenance of elite groups' is facilitated by this need.

There is a moment here to consider differing situations in northern and southern Mesopotamia. Styring *et al.* (2017:1) point out that the commonly-assumed model of Mesopotamia-wide high-labour agriculture has been founded on '[i]nfluential research based in southern Mesopotamia, where irrigation is obligatory and associated with high area yields'. They argue from a new base of isotopic and artefactual analysis for low-input large-area cultivation in the north, observing that '[t]he productive potential of northern Mesopotamia in recent times ... has depended on very extensive cultivation, augmented since the First World War by tractors, pump irrigation and agrochemicals, combined with effective systems of mobilization and transport.' This is reinforced by evidence of field shape: Liverani (2006:27) suggests that in the north 'square fields [were] connected with family exploitation', in

contrast with the long and narrow centrally-organised irrigated fields of the south (Chapter III.1).

Meanwhile, the information in the ancient texts themselves may be suspect. Commentators have explored a range of explanations for the remarkably-high yield ratios of seed to harvest in later 3<sup>rd</sup>-millennium BC Girsu and Umma texts (Halstead 1990:187-90, Maekawa 1984:82-5); Steinkeller (2004:73) argues specifically that figures in Umma texts for harvests, labour use and transactions in fact reflect 'a kind of "accounting reality" or even "accounting fiction"', as they are demonstrably largely written before the harvesting and after the projects and transactions. He suggests that these adjusted records are intended to supply planning authorities with statistical information, Liverani (2006:34) commenting that 'it was difficult to control what happened to the harvest after reaping – certainly after threshing – when it was easy to steal from it.' Adams (2008:19) proposes a very modern scenario in which the figures are perhaps adjusted by junior functionaries in order to avoid the severe penalties known to be meted out to those failing to achieve the high performance targets set.

The Sumerian centralised agricultural system, with its adoption of large-scale animal ploughing, may have fractured household-level social and economic operations, not only through physical reassignment of labour (including by gender: Chapter VIII.3) but through imposed changes of strategy and goals as may be mirrored in cash-crop animal-ploughing systems imposed by administrators in developing regions in the 20<sup>th</sup> century AD. Carswell (1997:4) suggests that official drives in sub-Saharan Africa to increase yield resulted in a see-saw at household level between quality and quantity of livelihoods, with increases per hectare coming at the cost of (p11) 'real losses in social, cultural and economic well-being'. No direct comparison is envisaged between the position in antiquity and modern authoritarian agricultural regimes, or examined in this thesis, but it may be possible to sketch out family-farming plough-adoption models from sub-Saharan Africa for the small private farms now thought likely to be continuing outside the Mesopotamian control system (Chapter II.1).

On smaller farms, modern African and Greek observation studies indicate that predictability of food resources is more of a key concern than yield (e.g. de Wilde 1967:53, Halstead 2014:350, Marshall and Hildebrand 2002:99-105), with an enduring preference among rural households for security and for balancing full use

of household labour (see earlier) with reduction of drudgery. Time-cost is therefore considered according to an 'internal equilibrium' (Low 1986:28) rather than with significant consideration of external concepts of yield and profit, reflecting Chayanov's (1986:xiv) model of peasant farming with 'the economic theory of wages irrelevant to family activity.' Delgado and McIntire (1982:189) conclude in West Africa that '[t]he return to family labor is an appropriate profitability criterion from the farmer's viewpoint in Africa's labor constrained systems'.

De Wilde (1967:76-7) reports how in an official drive in Tanzania to increase production of cotton, local farmers defied all injunctions and made the minimum effort required to gain enough cash to live on; APP II.31 lists further commentators on farming decisions outside official cash-crop operations, and on other factors such as younger family members migrating seasonally or permanently from farms to locations with plenty of work (APP II.31); changing household configurations militate against large fixed-cost investment (Halstead 1987a:85). Changes in the gender and age of the labour required (Panin 1988:174, Spencer and Byerlee 1976:878-9, and see Chapter VIII.3) also significantly affect the household socially and economically, as does the common practice of dealing with the new tasks through communal or cooperative arrangements (Carswell 1997:19, Farnham 1997:25). Jaeger and Matlon (1990:35) report how small-scale farmers in West Africa's semi-arid tropics are 'defying the logic of conventional choice-of-technique analyses', and Farnham (1997:34) adds that there has been very little focus by anthropologists on 'irrational economic behaviour' (p31) by farming households, with the field left largely to agronomists and to studies based on research-station yield experiments rather than social and cultural considerations (Chapter I.2). Halstead (2014:332) provides a summary of

anthropologists, historians, and archaeologists variously holding that farmers' decisions are:

- Constrained by identity, status, and values ... and so predictable only with detailed knowledge of a particular culture
- Shaped by "rational" cost-benefit considerations ... and so fairly predictable
- Determined by environmental and technological constraints and so highly predictable.

He concludes from ethnographic fieldwork among traditional Greek farmers that varying cultural choices may derive from differing practical historical circumstances,

and may have parallel efficiency (p332-8), citing Polanyi's (1957a) view that quantified analysis of costs and benefits is alien to nonmarket economies (p344).



## V.5 Ploughing models and realities

Isaakidou (2011:94) points out that

Boserup's [1965] model of agricultural intensification and technological innovation, driven by population growth, forms the explicit basis of Sherratt's scheme for the development of farming in prehistoric Europe,

with ox-ploughing diffusing from the Near East where 'aridity rather than forest clearance has tended to be the limiting factor'. She argues – as I set out in my research aims (Chapter I.1) – that Sherratt's secondary products model was taken up by commentators with

preconceived notions of technological progress and economic intensification, driven by growing human population density and an expanding urban world system. For those disinclined to investigate farming practices, it offered an attractively clear, off-the-peg springboard for more interesting forays into human social behaviour. The extent to which data were accommodated to the model, rather than vice versa, became increasingly clear in later expositions (Sherratt 1997, 2006) that largely overlooked the growing body of bioarchaeological evidence. (Isaakidou 2011:97)

Isaakidou implicitly underlines the weakness of Boserup's hypothesis as being based on a desire to explain the contribution of agricultural development to social complexity, rather than concluding from a bottom-up world study of modern and ancient agriculture that it enables or encourages (or stems from) certain aspects of social complexity. Boserup's model is based on South-East Asian evidence and a slash-and-burn scenario (Abernethy 2005:vii, Boserup [1965] 2005:12) inappropriate for the Ancient Near East (Oates 1980:304, Sherratt 1981:290). South-East Asian agricultural systems may have closer parallels in parts of modern Africa than in the Ancient Near East; but extensive development studies in sub-Saharan Africa again tend to negate the Boserup model, which is based on ploughing driven by land shortage and resulting in increased yield per hectare.

Overviews and survey results in sub-Saharan African regions indicate that African adoption of ploughing, often in light, arid soils, tends if anything to reduce per-hectare yield, and relies on good access to land (e.g. Jaeger and Matlon 1990:37, Makwanda *et al.* 2000:173), not least for providing fodder and grazing for working animals. The latter factor is underlined by Boserup ([1965] 2005:35-7) herself, notably citing diachronic studies in India which show that in regions feeding working animals on produced fodder, costs are far higher than in regions using common

grazing instead; but Boserup attaches this factor more to labour use than to land issues.

Manuring – which as posited by Boserup can aid yield – has not been popular in modern Africa, where traditional systems rely on good land availability rather than fertility (e.g. Landais and Lhoste 1990:221-3, Tiffen 1976:127), although there is manure deposition from grazing of pastoralists' flocks on resting land (Chapter VIII.4). Halstead (1987a:81) reports that in Mediterranean regions soil nutrition is less of an issue than water: '[a]t best, therefore, manuring offers an irrelevant improvement in soil fertility and at worst it accelerates water loss by opening up the soil'. Bogaard (2005:186) records modern agronomic evidence that while manuring can benefit crops in Near Eastern dry-farming regions, 'in lower rainfall areas ... manuring can be detrimental since it encourages early development of the crop, exhausting limited water supplies.' Oates (1980:304) rejects the Boserup model for ancient Mesopotamia on the grounds among others that dung deposited by grazing animals oxidises in hot, dry climates so provides little benefit (Charles 1990:53, Kjaerby 1983:29, McCown *et al.* 1979:304), especially in saline soil (Charles 1990:53), and that there is no ancient evidence of deliberate dung-spreading. Styring *et al.* (2017) provide (*contra* Oates) isotopic and sherd-scatter evidence of animal-dung and household-waste manuring practices in 4<sup>th</sup>-3<sup>rd</sup> millennium BC northern Mesopotamia; they argue, though, that this was most commonly practised in small-scale horticulture, from the 7<sup>th</sup> millennium BC onwards. In the large-scale monocrop sector which emerged in the Uruk period, manuring (which is heavy (Chapter VII.3) and labour-intensive) was likely to have been impractical:

[c]ereal grain nitrogen isotope values reveal that increased agricultural production to support growing urban populations in northern Mesopotamia was achieved by cultivation of larger areas of land, using lower manure/midden inputs per unit area – extensification. (Styring *et al.* 2017:9)

McCann (1995:85) reports that the history of the long-established ox-ploughing agriculture of Ethiopia again did not follow the Boserup model: farmers tended instead to use ploughing to extend hectarage but with low-yield practices as this incurred less labour cost; this is also reported in what is today Zimbabwe by Gourou (1961:123). Farnham (1997) also rejects the population-increase model of agronomists such as Pingali *et al.* (1987:4) and underlines the effect of the new need for feeding and maintaining the working cattle or (to a lesser extent) donkeys:

the success of animal traction in Africa appears to require abundant land for grazing and the extension of farmland. Contrary to Boserup's theory, therefore, it is most likely to succeed where population density is low. (Farnham 1997:24)

Hesse and Runge-Metzger (1999:226) and Kjaerby (1983:24-7), writing of Ghana and Tanzania, also explicitly doubt the Boserup model, particularly in low-rainfall regions, particularly for reasons of fodder and grazing. The assumption of increased yield nevertheless persists in academic discussion of the consequences of the introduction of deep (ox) ploughing at this period, as in Brewer's (2004:19) introduction to a re-publication of Engels' [1884] *The Origin of the Family, Private Property and the State*.

A further driver of urbanisation and social complexity commonly attributed to, and claimed as justifying, the advent of the plough (APP II.20) is the new ability of farmers to exploit marginal land – that is, areas with soil too poor to repay manual cultivation (Sherratt 2006:353). European models may relate to heavy clay soil, too arduous to cultivate manually; in the Near East it is likely to be rocky, steep or thin soil, suitable for grazing but not easily for cultivating, that qualifies as marginal (Halstead and Isaakidou 2011:62). The marginal-land cultivation model has more recently been questioned: Halstead (2014:59) points out that much marginal land in developing regions today is cultivated manually, the expensive plough attelage being kept for the main fields, and that its use incurs a loss of rough grazing land (Ruthenberg 1964:184) which must be replaced by fodder crops if working animals are being used.

Related to the issue of marginal or distant land is a factor again rarely included by commentators using the Boserup model, of the need to convey crops, people, implements and (if used) manure to and from these distant fields and indeed around any large farm, as would be necessary if exploitation of hectareage has to replace richness of soil. APP II.20 notes references by commentators to this likely need in antiquity, in Mesoamerica and in modern Africa; the constraints of this need, and the value of working animals available for farm-to-field transportation, is expanded upon in Chapter VII.1. This necessity forms part of yet another factor not always included in ploughing models, the economic importance of year-round utilisation of expensive ploughing animals used only for a short season annually. This element is noted in the *Debate Between the Hoe and the Plough* (Black et al. 1998-2006a:¶104-8), with the Hoe accusing the Plough that 'your effective time is four months and your time

of absence is eight months'. (APP II.31 gives references to African and other surveys and overviews giving evidence of this). Jaeger and Matlon, for example, report on a study of the household and practical reasons why farmers in regions of Burkina Faso have been slow to adopt animal draught power to replace manual cultivation, concluding that

farmers can profitably adopt animal draft power when household characteristics and exogenous factors permit high utilization of animals and equipment. Empirical analysis of farm-level data indicates that low utilization is the key cause of low returns. (Jaeger and Matlon 1990:35)

Sherratt in 2003 (p243) considers that 'the high costs of specialist draught animals' were justified by 'the use of oxen in the intensive cultivation of irrigated farmland in lowland Mesopotamia' and that other uses – threshing and eventually cart-pulling – developed in due course from this initial use. In a footnote in 2006 he adjusts this view, with attribution of some economic causation to non-ploughing use, though he then comes to a conclusion no longer current:

[u]tiliser un animal de trait à la fois pour labourer/ semer et pour dépiquer des céréales était un bon moyen de rentabiliser sa vie active, de même qu'à autres périodes de l'année son utilisation pour les transports: c'est probablement la raison pour laquelle le complexe de la traction animale a été diffusé comme un tout. (Sherratt 2006:346)

Obtaining profit from cattle in general is complex, as is indicated in Chapter IV.2. Bogucki (1993:497) concludes in discussion of early European use of working oxen that

[c]attle simply do not make sense as an investment for meat alone or only as insurance against agricultural deficits, particularly in an agricultural system in which the household was the primary productive unit.

An assessment of cattle in modern Asian farming systems by working-animal specialists Lawrence and Pearson (2002:104) makes the reverse point that '[d]raught work by itself is usually not profitable'. A key factor in successful adoption of working animals in 20<sup>th</sup>-century AD sub-Saharan Africa has been the additional income and general household benefit of using off-duty ploughing animals for transport (Chapter VII.1), not to mention the very common hiring out (or lending for social obligation) of working animals to others (Chapter VI.2). In mediaeval Britain ox use for ploughing was contingent on additional employment for hauling carts (Langdon 1986:290), and in Classical Greece where 'there must exist a close

connection between 'the agricultural year' and 'the construction year' (Isager and Skydsgaard 1992:104) so that the oxen can earn their keep by transporting building materials when not ploughing. Lawrence and Pearson (2002:99) record that in Indonesia and Nepal '[m]ost animals used for draught are multi-purpose and it is often products other than their work output which determine their profitability', with the 'yield per labour unit' of owning working animals by no means stemming entirely from ploughing.

While donkeys are more multi-purpose for transport, cattle can be sold for meat at the end of their life (see Chapter IV.2). Donkeys could have entered farm operations specifically for work, but cattle may well have been established farm animals before their systematic recruitment for ploughing, kept not only for meat and prestige but for milk and perhaps tasks such as threshing, riding or pack (Chapters I.2, II.1). As illustrated in sub-Saharan Africa, these invite and require closer husbandry relationships with the animals than with pure meat herds.

Lack of appreciation of these multiple factors, agriculturally technical and requiring close knowledge of the region and the local culture, often frustrated the efforts in late 20<sup>th</sup>-century AD Africa by government agencies and NGOs to introduce animal traction on the Boserup model, as is outlined in Chapter I.2 and as admitted by Boserup herself ([1965] 2005:65). Although the centrally-driven African situation bears only faint parallels with 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia where administrators had more control over workers' lives and actions, modern African governments did exercise sway in some cases by subsidising animal, implement and fertiliser purchase and by imposing regulations unsuited to local practicalities on use of animals.

## V.6 'Intensive'/'extensive': confusing terminology

There is some confusion in the terminology for different styles of farming. The term 'intensive' is quite widely used for large-scale centrally-organised farming (APP II.31); Sherratt does similarly in broad discussion (1981:262) but shifts to 'extensive' (1981:292, 2006:352) in specific comparisons with 'intensive' horticultural systems; other writers too mix their appellations. Goody in 1971 (p25) uses 'extensive' for Africa's non-plough agriculture and 'intensive' for ploughing; in 1976 he again refers on p24 to 'intensification' as relating to ploughing but on p32 to male-dominated 'extensive plough agriculture', with 'intensive' applied to manual cultivation. Earlier in the same work Goody (1976:20) uses the alternative terms 'simple' and 'advanced' for manual and plough cultivation.

Boserup ([1965] 2005:43/73) defines intensification as relating to more frequent cropping as opposed to (p65) the 'extensive' pre-colonial system; Shenk *et al.* (2010:66) define intensification as more yield per hectare and larger fields, and Gurven *et al.* (2010:50) as associated with 'monocropping and clearcutting'. In contrast, Bogaard (2004:21, 2005:179), Halstead (APP II.31), Styring *et al.* (2017) and others relate intensive farming to small-scale mixed cultivation with high family labour input and modest use of working animals to reduce household labour rather than to increase the scale of cultivation significantly. Some commentators deal with the issue by classifying this form of intensive agriculture as horticulture and including absence of plough use in the definition (Borgerhoff Mulder *et al.* 2009:685, Bowles *et al.* 2010:11). Gurven *et al.* (2010:50) meanwhile differ from some in considering horticulture low-intensity and low-yield. McCown *et al.* (1979:304) go further in separating intensive horticulture from shifting agriculture as well as from extensive large-scale animal-ploughing agriculture.

Carswell (1997:1-11/21) addresses the terminology issue in detail, concluding that 'intensive' implies increase in yield per hectare whatever the cause (demand for more food, land or labour limitations) or effect. 'Extensive' implies increase in land, without an increase in labour input per hectare. Bogaard (2004:21) similarly defines extensification as involving 'smaller inputs of labour per unit area, resulting in smaller area yields'. Styring *et al.* (2017:1), in a detailed study of Mesopotamian agricultural modes, define intensive agriculture as involving an 'increase in inputs, resulting in increased crop yields per unit area of land' through high-labour practices such as manuring and weeding; agriculture based on significant expansion of

cultivated land, as enabled by animal ploughing, is defined as extensive, 'such that reduction of inputs and yields per unit area are offset by a larger absolute scale of production.' Farnham (1997:23) comments that

where animal traction has had an impact on production, it has generally involved a pattern of land use based on extensification, rather than intensification.

The terminology confusion may form part of the problem of discussing these modes of cultivation, as it is sometimes not made clear exactly what is being intensified. In this document I shall if necessary follow Bogaard, Halstead *et al.* in referring to small-scale high-labour farming as 'intensive', or on occasion follow Goody (1976:20) in using 'simple' and 'advanced'.

## V.7 Implications for early use of working animals

Ploughing is not necessarily an advance over manual cultivation. And ploughing can be deeper than manual digging, but this can be inappropriate for light, arid soils, resulting in desiccation. Ploughing opens the soil more speedily, but leads to a concomitant extra labour-burden per farm of weeding and harvesting, and sometimes of preliminary field-clearing, as well as of the care and feeding of the working animals. Comparison of hoe and animal-plough cultivation involves a huge range of factors, including environment, equipment, available animals, and existing and available extra labour. An analysis of more than 100 studies of the adoption of working animals indicates that key uptake factors are cultural constraints, labour availability, entry cost, and familiarity with animals.

Boserup's model of the adoption of ploughing, taken up and developed by Sherratt and others for envisaging the advent of plough agriculture in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, was founded on a hypothesis of land shortage and a population-driven demand for greater yield (APP II.20), intertwined with a concept of technological progress. Versions of this model were adopted by a number of modern colonial and post-colonial authorities and institutions overseeing the 'development' of agriculture in sub-Saharan Africa; many were found to be inappropriate, imposed by urban officials without appreciation of local practical and cultural factors. Ploughing was commonly found not to increase yield per hectare, and was most likely to be encouraged by good land availability – particularly in view of the need to grow fodder or at least provide local grazing for the ploughing animals. The presumed inequality from ploughing-animal ownership is turned on its head, as owners of ploughing animals seek means of year-round utilisation, including hiring out teams and doing transport and agricultural work for others (see my research aims).

Top-down models of the adoption of plough agriculture commonly risk 'leaving out the animals', notably factors arising from the different virtues of oxen, cows and donkeys (Chapter III.1), which can apply to large and small farms alike. The use of donkeys commonly has a favourable impact on the lives of women, who may already be burdened by increased plough-generated field tasks such as weeding but may in particular be disenfranchised by male-exclusive oxen-handling prerogatives. Meanwhile, modern official promoters of agricultural regimes are often baffled by the lack of profit motive among smaller farmers, and frustrated by



preferences for reduction of drudgery for family members, often achieved by use of working animals for transport rather than for ploughing.

Comparisons between colonial agricultural regimes in 20<sup>th</sup>-century AD sub-Saharan Africa and the centralised farming system in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia must be resisted, though both featured cash crops and a focus on yield, with a belief in plough-led systems, and the practicalities of animal capabilities and management – often unmentioned – can certainly be addressed through modern analogy. Modern sub-Saharan African studies may also provide valuable insight into the operation of small farms, increasingly acknowledged as present at the same period and inter-relating with the large centralised farms on labour supply and crop production (Chapter II.1). Overall, though, the realities of the adoption of ploughing animals, as evidenced through modern studies, is a vast subject, to which no sort of justice can be done without straying far beyond my thesis subject.

## VI WORKING ANIMAL MANAGEMENT

### VI.1 Grazing, fodder and feeding

#### *Introduction*

The systematic adoption of working animals in antiquity had the likely result of significant changes of labour and fodder-crop patterns, as strategies were established to address the timetabling and feeding needs of working cattle in particular. In this chapter, pursuing my research aims of exploring daily life with working-animal use, I discuss the evidence on this subject from ethnographic studies of working animal adoption by African hoe-farmers, giving pointers to the scale and nature of these changes and suggesting routes to their archaeological detection. I also examine the widespread physiological and ethnographic evidence of the advantages of donkeys over working cattle in terms of food processing efficiency and ease of feeding. Choices of working animal at any stage reflects a range of influencing factors such as changing tasks and labour availability, but as with female cows (Chapter III.2), evidence of increasing substitution of donkeys for working cattle in antiquity might indicate deteriorating environmental conditions, as occurs in regions of Africa today.

#### *Fodder and nutrients*

##### Extra feeding of working animals

When working animals first replaced humans, a significant element of the intended economic benefit may have been the change from feeding human workers to allowing animals to feed themselves by grazing. The equation is altered if food has to be grown and/or carried to animals; extra feeding requires extra labour (e.g. Starkey 1989:36) as well as organisation (de Wilde 1967:110), so the equation outcome is contingent on the labour/ cash/ land cost of the fodder and the value of the extra work.

An often-mentioned concern for working-cattle users is the requirement for extra nutrition in the immediate run-up to ploughing, commonly mentioned in feasibility and outcome reports on the adoption of working cattle in sub-Saharan Africa, and by Halstead and Isaakidou in commentaries on traditional farming in Greece (APP II.3). Pearson and Smith (1994:123) and others (APP II.3) report that in cattle the

extra energy cost of working is in fact not high, but the low quality of feed available at the end of the preceding dry season is a prime issue in sub-Saharan Africa. Productivity can suffer severely as the animals lack the necessary strength (e.g. de Wilde 1967:110, Halstead 2014:52, Panin and Ellis-Jones 1994:98), perhaps necessitating more animals per plough (Chikura 1994:162, Kjaerby 1983:148, Pearson and Smith 1994:124). Once working, the cattle also lack sufficient time to graze or ruminate. Pre-ploughing nutrition for cattle is a burden which has contributed in various parts of Africa to the low adoption of animal traction by hoe farmers (Orev 1972:236, Phiri 1994:144, Starkey 1991:80) or to a shift to use of donkeys. Donkeys are not generally considered to need extra feed in the run-up to ploughing (APP II.3); they commonly graze at night, unlike cattle, and are physiologically more efficient processors of food, as described below. Against this, in terms of overall cost, is the greater carcass value of ploughing oxen at the end of their life (Chapter IV.2).

Stall- or pen-feeding with fodder of various kinds can be evidenced back to at least the early 4<sup>th</sup> millennium BC in Europe, and in Egypt and Mesopotamia to at least the 3<sup>rd</sup> millennium BC (Russell 1988:15). Texts from late 3<sup>rd</sup>-millennium BC Girsu and Nippur indicate a ratio of 2:1 of barley sown to barley 'fed to the animal set to the seeder-plow' (Maekawa 1984:78), and similar ratios of wheat or legume seed to plough-animal fodder, though Sherratt (2006:346) reports a ratio of 1:1 in a text from Lagash (c.2400 BC). Stol (1995:195-6) reports wide variations in working-cattle barley rations cited in early 2<sup>nd</sup>-millennium BC texts, perhaps depending on the type of work being done, or the availability of grazing as was the case in Northern Mesopotamia. In the 2<sup>nd</sup>-millennium BC Archives Royales de Mari, '[w]e learn from some letters that ... they tended to feed the animals too much which resulted in disease' (Stol 1995:196). Texts from mid and late 3<sup>rd</sup>-millennium BC Mesopotamia (referenced in APP II.42) set out the feed rations for donkey and hybrid teams pulling vehicles or ploughs, probably part of intensive operations in which grazing is not an option. Feed is recorded as being supplied to draught and plough donkeys, and to donkeys and cattle in the winter; contextual information on the related burden of work and availability of grazing is generally lacking, and there is some debate among commentators about ration volumes, particularly as the donkey-handler's wages may have been included in the ration allowance. The cost of fodder (mainly straw) is sometimes included in the cost of pack donkeys in later texts concerning the early 2<sup>nd</sup>-millennium BC donkey caravans between Aššur and Kaneš in Anatolia (Dercksen 2004:266, Larsen 1967:121); Barjamovic (2011:37) notes that the inns

on the route must have been large-scale growers (or buyers-in) of animal fodder. On the zooarchaeological side, Champlot *et al.* (2010) have analysed the bones and teeth of forty onager-donkey hybrids found at Umm el-Marra in northern Mesopotamia in an elite human burial from the 3<sup>rd</sup> millennium BC; the conclusion that they were used to pull heavy loads and that they did little grazing chimes with Postgate's (1986:196) note from later 3<sup>rd</sup>-millennium BC texts that extra fodder was given to hybrids pulling chariots.

The textual evidence underlines the importance of proper foddering arrangements for donkeys intensively used away from environments permitting foraging of any sort. This latter is found in donkey-caravan work throughout history, and in urban equid management as exemplified by McShane and Tarr's (2006, 2007) accounts of the city horse transport systems of 19<sup>th</sup>-century AD America, in which horses were considered as "cyborgs", or as "a melding of the mechanical and biological", and as machines for 'turning food into money' (McShane and Tarr 2006:365). There are modern African accounts of donkeys doing heavy transportation work being given extra feed (Admassu and Shiferaw 2011:33, Starkey 2000b:19, Swai and Bwanga 2008:ii), but in general there is a marked divide in both the past and present between the low-key household use of donkeys common in rural Africa (relying on the donkey's ability to forage for itself) and heavy-duty 'commercial' exploitation of equid power. It is on the former, local function of donkeys that I am focusing in my thesis generally, not only by reason of the ethnographical data set upon which I am basing my discussion, but with the aim of redressing the absence of examination of this lowly function of the donkey in antiquity.

#### Nutritional value of fodder

Another underrated element in the feeding model is the nutritional quality of fodder for cattle and the implications of the need to add high-nutrition fodder crops to the agricultural mix (Halstead 2014:52, Jabbar 1993:263, Starkey 1989:36), as 'draught cattle work ineffectively unless fed grain or nutritious gathered fodder in addition to coarse crop residues' (Isaakidou 2008:105). Kjaerby (1983:157) notes that stall-fed oxen return only c.3-5% of the energy contained in fodder; Smith (1991:211) records that if food quality is poor, in hot regions oxen may not be able to maintain weight no matter how much they eat, with diet and management having a direct effect on their energy output compared to input. Cattle being given dry feed also need considerable extra water, at about four times the volume of feed (Renger

1990:273). Insufficient high-quality feed can also slow reproduction in working cows (Harun *et al.* 2000:48).

Professional working-animal handlers have long known that attention to nutritional value pays dividends. In 19<sup>th</sup>-century AD USA, owners of the many working horses in New York 'tracked fuel costs with great precision' and discovered that feeding cornmeal rather than the same quantity of oats provided a lower work return: the reason was not known then, but it is now recognised that cornmeal lacks niacin (McShane and Tarr 2007:368). Renger (1990:273), referring to sub-Saharan Africa, explains the importance of giving cereal, with its high starch content, to working cattle in addition to hay or straw (though wheatgrain is fatal to equids as it causes colic (Borwick 1981:121)). In highland Ethiopia there has been a trend towards 'plantings of sorghum over the more marketable tef because sorghum stalks and straw are more nutritious than tef straw' for their ploughing oxen (McCann 1984:5); such crop choices in antiquity can help to indicate the presence of working cattle. Meanwhile, cattle-herders in Kenya and Tanzania have knowledge of which plants can correct mineral deficiencies and improve the animals' condition (Ruthenberg 1983:334); Starkey (1981b:23) and Bangura (1988:297) report that feeding of 'mineral supplements known as tupal [prepared] from a mixture of selected leaves, termite hill soil and common salt' (Bangura 1988:297) to oxen in Sierra Leone before ploughing obviates the need for extra fodder beyond grazing. Barrett *et al.* (1982:37) and McCann (1984:5) also report salt being given. In Burkina Faso, working animals are given sorghum straw or hay or compressed leavings from oilseed pressing, in addition to grazing; the farmers interviewed (JG Burkina Faso 2013) were unanimous that the outlay was worth it for the improved work-rate obtained. Ploughing oxen in Nepal are given special plants and brewing residues (Campbell 2005:88), and the yeast theme is also noted in antiquity: in 3<sup>rd</sup>-millennium BC Egypt fatted cattle were given extra nutrients by feeding green produce and dough (Brewer *et al.* 1994:86), and Stol (1995:196) notes early 2<sup>nd</sup>-millennium BC Mesopotamian texts listing beer-brewing residue fed to cattle for fattening. Nutritional variations in grazing are therefore an issue; Barrett *et al.* (1982:39) note in Burkina Faso that most cattle-deaths from disease are in the dry season when there are the lowest levels of minerals in grass and crop residue. King reports for example from a study in Kenya that

[i]t is common knowledge among herders that the quality of soils and the associated vegetation strongly control the health of grazing animals. This is

hardly appreciated by palaeoanthropologists, who generally assume that all that is required is water and vegetation. .... If it lacks vital trace elements (e.g. phosphorus, sodium, copper, cobalt) then wild grazing and browsing animals will avoid it and go to considerable lengths and take major risks to seek out better pasture. (King 2014:13)

### Sourcing of fodder

Crop residue, though insufficiently nutritious for pre-work feeding-up, certainly forms part of the diet of working cattle, and in modern times donkeys are commonly fed in this way if they cannot forage freely (Blench *et al.* 2004:213, Hassan and Ibitoye 1993:141). The use of residue has the advantage of increasing the return from a mainstream crop rather than turning land over to fodder-growing, which in highly-populated areas is problematic (Admassu and Shiferaw 2011:51, de Wilde 1967:110-11). Making use of the residue from cereal crops, though, involves extra labour in cutting crops low to obtain the straw, and threshing and winnowing them to allow grain and straw to be used separately (Brodie 2008:303, Halstead 1987a:84, Halstead 1995:12, Halstead 2014:50); varying heights of crop-cutting have been detected in prehistoric Europe, giving indications of straw use for fodder (Halstead 2014:51/176). Early threshing practices have attracted recent archaeological interest (APP II.25), with potential for detection of production of animal feed: Whittaker (1999:13) explains for example that sledge-threshing rather than flailing or treading can assist if cereal crop residue is to be chopped into chaff for animal feed and other uses.

Extra nutritional feed can include foraged wild plants (Russell (1988:15) notes evidence of cattle stall-fed with branches from at least the 4<sup>th</sup> millennium BC in Europe), specialist crops such as bitter vetch grown solely or mainly for animal use (Halstead 2014:52-4, Kjaerby 1983:28), and crops such as barley grown for both human and animal use. Early 2<sup>nd</sup>-millennium BC texts report cattle being fed grass, barley, beer-brewing residue, straw and reed (Stol 1995:195). Hay is less labour-intensive than specialist crops to harvest (Halstead 1995:12, Isaakidou 2008:105), though bulky to carry; it is more nutritious than straw (Halstead 2014:52) but less than legumes, and swiftly loses nutrition during storage (McCown *et al.* 1979:306). Wilkinson (1972:31) suggests that 'archaeologists tend to underestimate the amount of labour' needed for the fodder industry; output per man-hour is reduced and costs increased (Boserup [1965] 2005:35-41); the considerable organisation of harvesting and storage (Reh 1982:99) may well alter the balance of common models for

working animal use. Barrett *et al.* (1982:7/25) give a very relevant account of hoe farmers in Upper Volta (now Burkina Faso) adopting working animals and struggling in particular with learning how to conserve forage and formulate rations, and to reallocate their labour force to deal with forage and pasturing. Meanwhile, multi-use or specialist fodder crops may put pressure on the land available for human-use crops (APP II.1); although new land may be made useable with the new animal traction capability, the labour of sowing and reaping increases. Isager and Skydsgaard (1992:111) note too that in Classical Greece small-scale farmers were more likely to cultivate annual crops rather than perennials which would require setting aside fields for fodder for several years.

Indications of the implications of the new foddering requirements accompanying the systematic use of working animals can be drawn from accounts of the massive hay industry that grew up in 19<sup>th</sup>-century AD New England and Britain, with the rise of urban populations unable to grow their own fodder and making extensive use of working equids; APP II.20 lists accounts here and in modern Ethiopia and Pakistan of urban fodder provision. Town horses' work was generally not seasonal, unlike hay supply, so a market system rapidly developed, with payment sometimes in manure brought back directly from the hay market. 'Pure hay farming was a highly specialized business' (Thompson 1983:63) and very risky; farmers often carted other farmers' hay as a sideline, and the cheaper option of transport by water was exploited where possible. In America, from the time of the first colonies in the New England and Mid Atlantic regions,

[c]olonists extensively farmed the natural saltwater marshes and freshwater meadows near the cities to provide salt hay (*Spartina patens*) for their livestock. (McShane and Tarr 2007:130)

However, upland hay (from alfalfa, timothy, clover and other crops) is much more nutritious, albeit much less convenient to transport than the waterside salt hay. By the mid 19<sup>th</sup> century AD, upland hay's nutritional value weight for weight, assuring its popularity in the lucrative urban markets, had become New England's major crop and a key part of the state's economy; the state authorities therefore urged citizens to use the salt hay locally for farm animals, bedding and manure mulching in order to free the valuable upland crops for export to the cities (McShane and Tarr 2007:130). Hanjra and Lateef (1993:130) report that in urban Pakistan too the diet of working animals is more nutritious than in rural areas as it features green fodder, chopped hay and concentrates.

In countries such as the Gambia today fodder demand in urban areas has an important effect on the rural economy, and in Syria, Egypt and India fodder-growing and -carrying are still huge industries (Pingali *et al.* 1987:95, Paul Starkey pers. comm. 2011). While overall the issue of transporting fodder for working animals may be self-solving in some circumstances, the location of fodder crops may well, as in the American example above, be distant from the working animals consuming the feed. Local transport animals therefore form a key element of the ploughing system (Isaakidou 2011:103, Starkey 1994a:76): in Ethiopia and Greece crop residue is transported from the fields by equids but given to oxen (Admassu and Shiferaw 2011:33, Halstead 2014:50). Isager and Skydsgaard (1992:105) comment on the complex organisation of fodder that must have been required in Classical Greece for the oxen diverted to transport of building materials (likely to be distant from normal fodder sources) outside the ploughing season.

### ***Grazing for working animals***

#### Grazing issues

If grazing is to be used during the working season, the conundrum for the keeper of working animals is how to allow them to graze for long enough (and on sufficient nutritious material) every day to replace weight lost through work effort (Starkey 1989:36, Temesgen 2000:73). A fundamental factor is therefore that the grazing area should be sufficiently near the working area (Dahl and Hjort 1976:241, Reh 1982:97, Urga and Abayneh 2007:5); as touched on above, arranging grazing for urban transport animals can be particularly problematic as they often work long hours (Admassu and Shiferaw 2011:33, Kumwenda 2004:150). A further factor for cattle especially is the need to centre the grazing area on a water source, which restricts the grazing radius (Dahl and Hjort 1976:238, Russell 1988:59); in Mesopotamian regions today working cattle are generally grazed on cultivated land (Potts 1997:82) or 'riverine land with permanent pasture' (Oates and Oates 1976:120), with fodder a continuing issue (British Admiralty 1943:269). An Old Babylonian early 2<sup>nd</sup>-millennium BC letter comments "Perhaps the ú KIN ... Attâ will tell you 'There is pastureland (*rītum*) of the oxen' – (well), the entire Euphrates is pasture land!" (Stol 1995:184), though this was not open to all, and payments for using pasture land are recorded. Zarins (2014:223/256) suggests that despite



grazing shortages, this (with grain supplements) was the main working-animal feeding system until later in the 3<sup>rd</sup> millennium BC.

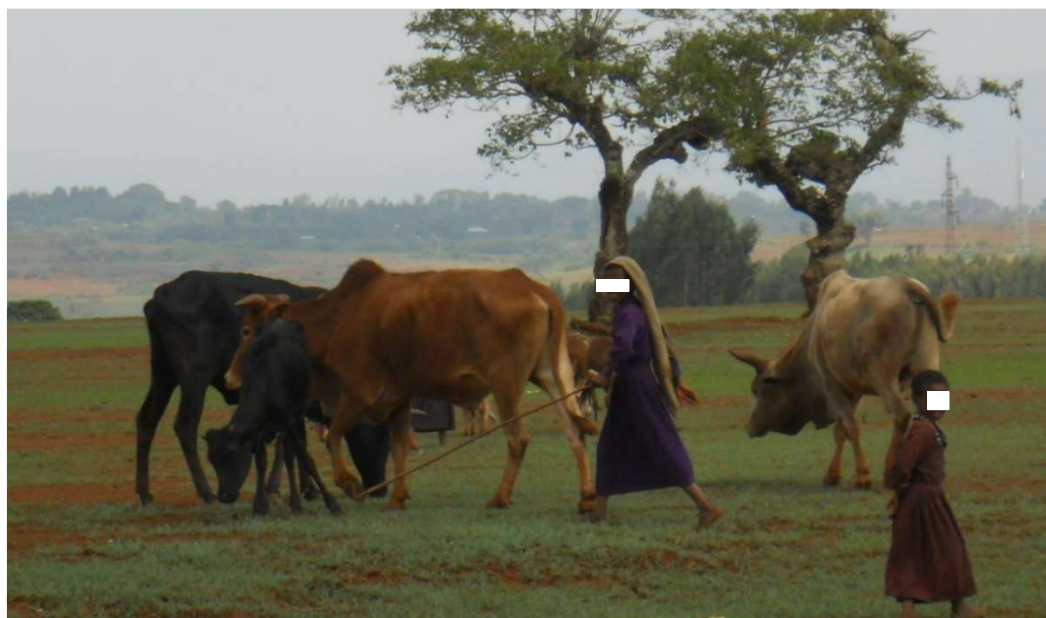
Kjaerby (1983:29) reports that in Tanzania 'plough cultivation has mainly developed in areas with agro-pastoral systems of land-use', with extensive grazing, though problems of course develop if cultivation increases beyond the carrying capacity of the grazing (e.g. McCann 1995:22 concerning Ethiopia). Pingali *et al.* (1987:95) conclude from African studies that as cash-crop focus increases, local grazing may go under the plough to be replaced by high-labour fodder crops. A lively debate revolves around the question of nomads pasturing their animals on stubble, with (possibly but not necessarily) benefits of manure, but I will not enter into this as it largely concerns non-working animals.

Keepers of working cattle in the Ancient Near East may have been under pressure to develop high-level husbandry systems, defined by Russell (1988:15) as feeding in pens or 'the grazing of herds on cultivated (often irrigated) pasturage specifically intended for herd consumption'; Russell (1988:15) adds that by at least the 3<sup>rd</sup> millennium BC 'both stall-feeding and fenced paddocks were employed with various herd animals'; such exigencies risk rendering plough cultivation less economic than manual (Kjaerby 1983:27). Grazing also may be controlled by potentially archaeologically-detectable practices such as tethering animals to moveable stakes, as still used in various regions today (e.g. Pearson *et al.* 2001:45, Theodossopoulos 2005:19, Wambui *et al.* 2004:28). The extra labour involved in such high-level husbandry may be partially mitigated by the greater ease of collecting manure, and the manure concentration itself may aid archaeological detection.

Difficulties over concentrated grazing for working animals can be numerous; there are issues of crop protection (Floor 2003:543) and security of the animals (particularly valuable trained ones) from theft, and of overgrazing (Dahl and Hjort 1976:246), particularly as cattle cannot easily graze where sheep, goats or donkeys have passed (Lattimore 1928:74, Spencer 1973:18). Intensively-grazed land also increases the likelihood of parasite infections (Barker 1999:276). Modern African adopters of working cattle may be forced to choose between year-round intensive maintenance or traditional grazing strategies which interfere with work timing. Farmers in arid regions such as central Burkina Faso and Nigeria traditionally entrust their (male) cattle to nomadic herders for at least part of the year, when there is insufficient feed or labour for the feeding work (Barrett *et al.* 1982:37, de

Wilde 1967:24), but herders' annual rounds take the cattle to a distant area at the critical working time; animals used for work therefore have to be managed intensively on-farm, with corresponding labour implications (APP II.1 lists commentators on this issue in Africa and elsewhere) and the challenge of mastering the husbandry skills (Barrett *et al.* 1982:37). In northern Namibia, cattle are grazed on communal pastures as in many regions, but due to growing drought the distances from pasture to farm are increasing, with the result that 'draft oxen may not be available for early land preparation' and the task is increasingly being given to donkeys (Haufiku *et al.* 2004:176). In regions with a different climate cycle, though, a transhumant system for working cattle is feasible, as illustrated in modern Georgia where some owners 'take their oxen to the high pasture to graze with the dairy and beef cattle' (Bradbury 2010:7), and on a smaller scale by Halstead (2014:293), noting cattle in 20<sup>th</sup>-century AD Greece moved to more distant pastures outside intensive working periods. Reh warns though that keeping cattle distant from the farm

is unsuitable for draught cattle even during the times when there is little or no work, since continuous contact with and daily handling by the farmer and his family are essential to ensure that the animals do not become wild. (Reh 1982:108)



*Figure 31: Children herding grazing cattle, Warkamla, near Bahir Dar, Ethiopia (© JG Ethiopia 2014)*

Communal grazing near the working area can lessen the individual burden for owners but present its own management issues, as is discussed in Chapter VI.2 in

the context of communal ownership of working cattle. Starkey and Apetofia (1986:15) report for example that in many cases of communally-owned grazing in West Africa 'the lack of agreement on grazing arrangements has inhibited the adoption of draft animals'. They add, though, that this may well be a cultural issue as many villages in Nepal and Indonesia successfully cooperate in setting aside specific areas for grazing. A common resource for herding is children, who have been an important labour factor in livestock care (see Chapter IV.2 and APP II.5, and Figure 31), probably since the earliest domestications.

Grazing for ploughing donkeys generally offers fewer obstacles than for working cattle, as is discussed below, but feeding long-distance pack donkeys presents particular issues, as working donkeys typically need to graze for at least six hours if supplementary feeding is not available (Förster *et al.* 2013:195). In the Old Assyrian texts dealing with the major pack caravans between Aššur and Kaneš in Anatolia in the early 2<sup>nd</sup> millennium BC, there are mentions of fodder (see above) but few of the matter of grazing. Dercksen (2004:267) describes a reference to the unloaded donkeys being kept in a yard (as in Figure 32) or enclosed paddock (with the merchants paying the paddock owner), or at pasture outside the town, watched by a local herdsman.



*Figure 32: Donkey-park at a market in Takhar, Afghanistan (© Stephen Blakeway 2012, by permission)*

Barker (2012) makes the illuminating point that in post-invasion Mesoamerica mule-caravan scheduling took account of time needed for the muleteers to plant fodder crops; from a different point of view in modern Bolivia, the timing and route of llama-caravans is significantly affected by feeding considerations (Nielsen 2001:166), with some areas short of grazing or featuring poisonous plants, requiring the carrying of fodder (Nielsen 2001:170/185). Joubert (1995:130) reports similarly the considerations of grass quality in timing and routing of ox-drawn wagon-trains. Lattimore's (1928:49) description of arrangements for camel caravans in modern Mongolia also describes how caravan timing was arranged to coincide with the grazing season at the unloading point, where local landowners charged a fixed fee per camel monthly for grass and water; caravaneers concentrated on feeding up their strongest camels, leaving weaker animals to forage for themselves. Mattingly *et al.* (2007:345) discuss the potential effect on local pastoral groups of the need for grazing or fodder for the many pack donkeys involved in the transportation of Negev copper and ore in the 2<sup>nd</sup> millennium BC, with the attendant issues of how grazing rights were asserted or arranged, and fodder organised.

#### Physiological aspects of grazing

A key differentiator between the husbandry methods appropriate for cattle and for donkeys is their physiology in relation to feed and water; a short explanation therefore follows. Both cattle and equids process their food by fermentation; in cattle this occurs in the rumen, and in equids in the caecum – 'a blind sac at the junction of small and large intestines' (Janis 1976:759) – with an enlarged colon for storage. The rumen has limited capacity, and the rate of passage through the system is restricted by particle size (Janis 1976:764, Smith and Pearson 2005:14), while the equid digestive system allows processing of bulky fibrous material (Gilbert 2002:16, Janis 1976): '[d]onkeys' tough digestive system can break down near inedible vegetation and extract moisture from food more efficiently' (Yilmaz 2012:17). Jones (2008a:12) reports that while for (zebu) cattle almost half their intake must be high in carbohydrate and protein, for donkeys the figure drops to one-sixth, with much less need for total food and for high-nutrition food (Yilmaz 2012:35).

Left to their own devices, donkeys consume dry grass, bark, leaves, twigs and roots of preferred species of plants, even creosote bushes in desert areas – not because they are hungry, but because they like them. ... Donkeys can become ill on rich food such as alfalfa/lucerne and lush spring grass. (Yilmaz 2012:69)

Donkeys, with their strong jaws (Burden and Thiemann 2015:378), are more ready than cattle to browse on woody species (APP II.14), and there are accounts of donkeys surviving on bark, fish bones, kitchen waste, paper and equid manure (APP II.14 and see Figure 33), though performance improves with better nutrition (Starkey 1998b:6). Cochin (1995:58) suggests that the donkey is 30% more valuable than the ox in terms of energy available for work in return for energy consumed in food, and Barrett *et al.* (1982:37) report from Burkina Faso that it costs four times more to feed oxen than donkeys.



*Figure 33: Donkeys foraging in rubbish, Mekele, Ethiopia (© Donkey Sanctuary Ethiopia 2009, by permission)*

Models of working-donkey husbandry systems in the present day are sometimes contradictory and driven by assumptions based on studies of other equids such as horses and zebras, by local prejudice or by mistaking of cause for effect: in South Africa, Starkey (1994b:4) reports from a survey in South Africa that

extension workers in several different areas stated that donkeys fed 24 hours a day, ate far more than an ox and were responsible for erosion and the degradation of the pasture. The frequency that such dubious statements were repeated suggests they may have come from some elementary text.



Starkey (1994b:5) adds that '[t]he donkeys were brought in because of the environmental problems: they were not the primary cause of them.' Pearson (1998:25) reports similarly that

[d]onkeys are often accused of causing environmental degradation because of their apparent preference for short grasses. Account is not taken of the fact that donkeys are mostly found in fragile ecozones and in numbers exceeded by other stock.

The confusion may also arise from the ability of donkeys to alter their foraging strategy according to availability: donkeys – both domesticated and wild – are readier than cattle to select for greater nutrition when there is ample forage and/ or they have already eaten well, while in times of hunger or poor grazing they are uniquely well-equipped to process large amounts of low-quality forage (APP II.14).

There is ample support for the hypothesis that donkeys do and did not require anything like as much herding/ pasturing as working cattle, and that they therefore escape the 'grazing trap' described above. 'Farmers joke that they seem to survive on air and sand' (Starkey 2011:17). Bulliet (1975:263) describes the similar benefits of grazing working camels on sub-marginal land, as providing a transportation resource at no cost to agricultural resources. Accounts are given in several African countries of donkeys released after work or in the dry season onto private or communal areas such as road-verges, or left to scavenge crop residue, dry grass and food waste (APP II.14). Donkeys are slower feeders than cattle and in the wild graze for longer, often at night (APP II.14). They are therefore often left to roam at night (Marshall 2007:379), though there are also accounts in several countries of their corralling to protect crops, to allow watering or feeding if grazing is poor, to allow rapid access during times of high demand for animal power, or to protect them from theft or predators (APP II.14). Cattle, too, may be confined at night if theft is a danger and herding labour is lacking (Little *et al.* 1999:56, Schneider 1979:88). In these cases the animals may need fodder, as is discussed above.

Evidence of increasing donkey use over oxen as an indicator of drought conditions is hinted at in Chapter III.1. Smith and Pearson (2005:1-2) report for example from livestock census and weather data in Zimbabwe and Ethiopia that 'annual fluctuation of cattle and small-ruminant populations closely follow variations in annual rainfall, whereas donkey populations remain stable'; this is partly because excess cattle can be sold for meat (see Chapter IV.2), but local farmers are

increasingly choosing donkeys for work because of their better survival in drought conditions. Unlike cattle, donkeys are native to semi-arid desert (Gilbert 2002:15-17, Groves 1974:110); again unlike cattle, they can seek food over a wide area daily (Jones 2008a:12) and range at least 24 hours from a water source (Smith and Pearson 2005:7). Assessments of the length of time that cattle and donkeys can go without drinking are often speculative or anecdotal; both are said to survive at least 2-3 waterless days, but it has been demonstrated by experiments that donkeys are significantly better able than cattle to withstand long periods between drinking without apparent stress or – importantly – loss of appetite, through a range of physiological and behavioural adaptations (APP II.3). Unlike cattle (and humans) donkeys can eat even dry food while severely dehydrated (Dill *et al.* 1980:975, Maloiy and Boarer 1971:37, Schmidt-Nielsen 1956:378); unlike cattle, they do not have to stand still to graze (Evenari *et al.* 1971:311, Sasson 2010:42), or to rest to ruminate after feeding (APP II.3), and their energy cost of walking is significantly lower than in cattle (Chapter III.1).

It should be borne in mind that African data on cattle physiology and behaviour often relates to animals with at least some zebu blood (see Chapter III.1 on *Bos taurus* versus *Bos indicus*), who are more heat-adapted in various ways and likely to suffer less from water deprivation than pure *Bos taurus* animals. Taurines such as N'dama cattle have shown themselves to be fully adaptable to heat, but care is still necessary when drawing inferences about cattle performance in the Ancient Near East before the later advent of the zebu strain.

### ***Implications for early use of working animals***

Modern African studies provide valuable examples of the feeding issues presented by operation of working animals unable to graze and needing extra calories and nutrition. Feed rations for working animals appear in texts from the 3<sup>rd</sup> millennium BC onwards, with reinforcement from zooarcheology and archaeobotany; nevertheless, there is very limited archaeological discussion of the probably sizeable foddering industry associated with early systematic use of working animals, and of its effect on labour patterns and the agricultural landscape. There is scope for new analyses of the implications of shifts away from human food-crops, particularly towards those offering concentrated nutrition for animals. These fodder-crops may be located on land further from settlements, or in place of over-grazed

pasture, leading to increased labour needs for carrying fodder and for keeping cattle penned.

Intensive grazing of cattle is recorded in antiquity (Zarins (2014) reports on textual evidence from the 3<sup>rd</sup> millennium BC) and has further potential for archaeological detection as evidenced in ethnographic examples; modern instances indicate that the presence of such practices has particular implications for social renegotiation in areas such as communal grazing.

Meanwhile, robust ethnographic evidence demonstrates that key differences in maintenance needs between donkeys and cattle lead to very different trajectories as work animals. The extra feeding required by working cattle can provide eventual payback in terms of carcass value, but there is a marked shift among farmers in Africa to the lower-investment strategy of donkey power. Donkeys are physiologically more efficient than cattle at food and water processing and more behaviourally flexible in their feeding needs. Unless they are far from natural forage resources and engaged in heavy pack or vehicle work, they are often self-maintaining. Particularly in times of environmental stress, their ability to work without concentrated pre-feeding in the dry season has contributed significantly to their increasing popularity over working oxen in Africa.

Accounts from throughout the African continent, of the expectations and actualities of adoption of working animals by farmers, give invaluable pointers to the learning curve experienced during their early systematic use. The ethnographic evidence is that the drawbacks of adopting cattle for work (notably labour demands for foddering and penning) may have been outweighed by levelling factors such as hiring out (Chapter VI.2). As discussed in Chapter III.2, working female cows may be favoured over oxen in regions 'characterized by insufficient feed resources to justify maintaining non-reproductive animals' (Starkey 2011:25). A different equation applies for the adoption of the donkey despite its more limited meat and milk potential: as described above, the ethnographic evidence worldwide indicates the high work return on very low foddering and grazing outlay.



## VI.2 Hiring, lending and sharing

### *Introduction*

The spreading of farm machinery utilisation among more than one user is common practice in modern times, and there is robust textual evidence that this was also an active facet of ox and donkey employment by at least the early 2<sup>nd</sup> millennium BC. Arrangements between owners and other users are recorded in legal and commercial texts from this period in Mesopotamia (e.g. Matthews 1978:86-9, Renger 1990:275, Roth 1980) and the Kaneš texts (e.g. Dercksen 2004:262-3/284), and in the mid 2<sup>nd</sup> millennium BC in Deir el-Medina in Egypt (Janssen *et al.* 2003:26-8/44). Following my research aim of re-examining the impact of working-animal adoption, in this chapter I suggest that the range and complexity of systems in modern Africa for hiring, lending and sharing cattle and donkeys for work, ‘an important, but hitherto neglected, facet of animal traction adoption’ (Hesse and Runge-Metzger 1999:226), can offer new insight for archaeologists into the mechanisms potentially affecting social equality as well as agricultural and goods-exchange development.

### *Cattle*

#### Owning versus hiring in/ borrowing of working cattle

From ethnographic and archaeological studies, a spectrum of potential social inequality relating to ownership of ploughing oxen can be established, as summarised in Table 5 below.

Investment in ploughing oxen and their equipment, and in their training and maintenance, is likely always to have imposed a significant entry cost for hoe farmers, to be recouped by the presumed benefits. As discussed elsewhere, this poses dual questions on possible social and economic responses to the early systematic adoption of ploughing oxen: can communities develop successful levelling strategies to reduce potential ox-related wealth disparity? (see Chapter VIII.2) and can owners implement systems which provide sufficient return on investment? In this chapter I argue that on the basis of robust evidence from modern Africa, the very widespread formal or informal temporary use of ox-teams and their equipages by non-owners goes a long way towards supporting both hypotheses.

Table 5: Levels of potential social inequality from ploughing-oxen ownership arrangements

<b>System</b>	<b>Operation</b>	<b>Potential social inequality</b>
<b>Individual ownership</b>	Use never open to many (unless subsidised)	High inequality
<b>Individual ownership plus commercial hiring</b>	Allows others with some means to use draught oxen, but is not open to all and can exacerbate inequality if entrepreneurs drive up the price of hiring	Moderate inequality
<b>Ownership plus a system of mutual obligation and assistance, though with specific and formalised recompense for the loan, e.g. labour required at key times</b>	Open to most but does not materially reduce inequality (Isaakidou 2008:105)	Moderate inequality
<b>Ownership plus a system of mutual obligation and assistance with long-term benefits</b>	Used widely in Africa among kin and neighbours; is open to all	Likely to be the point on the spectrum where there is least social inequality
<b>Communal or cooperative ownership of oxen</b>	Can be open to most but has been found in many cases in Africa to be unsuccessful as a system	Low inequality in theory but not in practice
<b>Central ownership, and hiring out or lending, as indicated for example in the Mari texts (Matthews 1978:86-9)</b>	Open to all who submit to central control but therefore imposes a different sort of inequality from one of simple financial exclusion	Inequality of power rather than finance

Overviews of working-animal use in several regions of Africa (notably Ethiopia, with its long tradition of ox-ploughing) emphasise the potential for inequality arising from oxenless farmers wishing to expand their operations. If production of a monocrop agricultural surplus is desired, tying farmers to narrow windows of activity, rapid cultivation capabilities can rank even higher than ownership of land; McCann (1995:80) argues with reference to recent Ethiopia that '[u]nless households owned oxen or had access to them, land had little economic meaning.' (See Chapter VIII.2 for notes on the complex social systems that consequently evolved there). Those

without working animals have to hand-cultivate or hire in or share oxen, leading to late ploughing and so to late sowing, with resulting increased risk of low yields or outright crop failure. Oxenless households may also have to lend household members in exchange at key times at the expense of their own fields (e.g. Peters 1986:140); a possible exit from this cycle is to send family members away to labour for wages. References to commentators on this issue in relation to sub-Saharan Africa and Greece are listed in APP II.10.

There is ethnographic support for a model in which the burdens of hiring or borrowing ploughing oxen form an incentive to or preparation for ownership. Hailu (1990:100) reports for example that in northern Ghana 'hiring seems to be a necessary prerequisite before complete adoption.' Kakwaba and van Leeuwen (1999:310), discussing Zambia, make the point that the pattern of ox ownership may shift frequently within a community, with farmers switching between owning and hiring according to their situation and external factors. Recipients of hired oxen, too, may be asked by owners to destump and generally prepare their fields in advance, to preserve the animals and equipment from injury (Muma 1995:45, Westneat *et al.* 1988:337); once these oxenless farmers have achieved this arduous preparatory work, and also have seen the new technology in action, some may well be encouraged to invest in oxen themselves (Westneat *et al.* 1988:337). Further references to this process are listed in APP II.10.

Conversely, there are modern examples (APP II.10) of a shift from owning to hiring ox teams (and their equipage), due to low capital or a fall in crop revenues, or following an increase in farm input costs, for example if 'costs of herd maintenance increase due to disease or increasing fodder costs' (Hesse and Runge-Metzger 1999:227) or the price of implements rises. In Nigeria, according to an Overseas Development Institute overview of West Africa traction-animal use,

[f]ew farmers can afford to operate a plough without hiring it out, as the cattle have to be provided with *dusa* (bran) and *harawa* (dried fodder) during the farming season. ... in a sample village in Kano State, ploughs were owned by only one family in 25, but ... virtually all families could manage to hire a plough for basic ridging. (Blench 1997:15)

The study adds that hiring in of cattle may delay ploughing but can be well-compensated for by the freedom from working animal management costs. In a district of Zambia Kakwaba and van Leeuwen (1999:308) similarly report that

[o]nly 13% of rural households own oxen but approximately half the cultivated area in Kaoma District is plowed under hiring and borrowing arrangements with ox owners. Most (51%) of oxen exchanges were on a sharing basis.... More than half of hiring transactions were to relatives, and relatives, especially women, had a high priority in terms of time of plowing.

Pingali *et al.* (1987:112) conclude from studies that a strong self-regulating factor within African communities, often in the form of hiring or lending ox-teams as described, soon erodes any competitive advantage from ownership of working animals. Other writers on Africa reinforce the speedy reversion to equitability that commonly occurs. A balance can also be made between human and ox labour, depending on the cost of hiring: for example, in Mali in a survey in the 1970s (Delgado and McIntire 1982:190-4) farmers found it very profitable to substitute rented oxen hours for hired human labour hours in the July seedbed preparation bottleneck, as long as the hired labour remained available for harvesting later.

#### Collective/ cooperative/ communal ownership

Hardin (1968:1244) was the initiator of the model of the tragedy of the commons, in which short-term self-interest leads to the collapse of communal stewardship systems such as grazing facilities and herding; but Dietz *et al.* (2003:1907) point out the many examples where 'self-governing institutions' have prevented or at least delayed this. Ostrom *et al.* (1999:278) use examples in north-eastern Asia to demonstrate that Hardin's model is a worst-case one and less likely to apply to an established cultural group and to a situation where (p281) 'the flow of resources is relatively predictable'. There has been only limited research into the present-day relationship between cooperative/ communal activity and animal traction (Farnham 1997:30); the few examples available provide valuable pointers for potential detection in antiquity.

Gboku (1988:317) reports on studies of working-animal adoption in India and Nigeria, in which high-adoption villages displayed a distinctive range of indicators of an established community structure and a culture of cooperation. Starkey and Apetofia (1986) instead contrast their overview findings in Asia and Africa:

[i]n both Nepal and Indonesia, it is common for villages to set aside specific areas for grazing. ...While such village cooperation might seem unremarkable, there have been many cases in West Africa where the lack of agreement on grazing arrangements has inhibited the adoption of draft

animals or restricted the integration of crop and livestock systems.' (Starkey and Apetofia 1986:15)

Peters (1986:141) reports on a successful system of mutual obligation and assistance in Botswana, where 'supra-household networks' arrange matters such as supply of draught animals or of an individual to care for cattle whilst the owner goes away to work; these networks tend to grow in size, absorbing unsuccessful groups. Owners of single oxen may, too, team their animals together and plough their land cooperatively (a practice known as 'yoking' (e.g. McCann 1995:78); a range of examples is referenced in APP II.10), a system which often operates more harmoniously than joint ownership of animals (Farnham 1997:149). Isaakidou (2008:105) suggests that such 'mutual assistance or exchange' systems may be detectable archaeologically through the stylistic uniformity of ceramics resulting from a 'strong collective identity'.

Luhmann (1988:94) suggests that 'unconditional trust is generated in families and small-scale societies and cannot automatically be transferred to complex societies'; to achieve such a transition, this trust would need to be replaced by a hierarchy enabling group cooperation including responsibility for tasks. As frequently evidenced in studies in Africa in particular, communal ownership on a larger scale cannot easily be imposed without the presence of solid mechanisms for its effective regulation. Starkey (1991:83) reports that well-meaning post-colonial agencies in several countries in 20<sup>th</sup>-century AD Africa attempted to introduce animal traction through communal ownership, with often unsatisfactory results. Key sticking points were the seasonal nature of draught animal use, resulting in demand bottlenecks, and (as referred to above) the sharing of responsibility for maintaining the animals year-round, including ensuring sufficient grazing, preventing theft and restraining them from damaging crops (e.g. de Wilde 1967:108, Steel 2000:168-9). This raises the question of the means of enforcement of systems such as that described in the 2<sup>nd</sup>-millennium BC Mari texts, where traction oxen and associated ploughing equipment are recorded as being government-owned and contracted out to villages, with payment in crops or manpower (Matthews 1978:86-94); there is a suggestion that this might usefully allow semi-nomadic groups to plough their land using oxen, but also evidence that many of these then failed to show up when summoned for labour in return.

Long (1968:22) reports on cases in Zambia where initial good cooperation facilitated initial adoption of ploughing but that the development of larger systems involving cash-cropping led to the dissolution of previous matrilineal villages into individual family units as plough-users' interest in individual land ownership grew. Vall and Lhoste (2003:17) suggest that with this greater scale, '[s]ocially speaking, animal power has encouraged the emergence of more modern, individualistic agriculture, by helping to transform certain communal tasks into family tasks (weeding, preparing the land)'. Such social evolution may be detectable archaeologically through settlement and dwelling spatial analysis, including indications of individual ownership of animals (e.g. Barker 1999:273-9), and perhaps by correlation of changes in burial practices, as with the shift to individual rather than communal graves with the advent of working animals in early 3<sup>rd</sup> millennium BC Europe (Drenth and Lanting 1997:53-4).

#### Lending and hiring

Lending and hiring differ from communal ownership in that they benefit individuals possibly at the expense of others in the community. Issues to address here are: Does both providing and receiving temporary use of a working animal provide social and financial benefit? Is this benefit greater if a kinship-based lending system is in place rather than formal hiring arrangements?

In Chapter VIII.2 I outline elaborate Ethiopian cattle-loaning systems, for use for milk or draught power, which reinforce and suppress social inequality in their different forms. Similar systems – known as *mafisa*, *magazo* or *kimanangan* – exist throughout sub-Saharan Africa, with cattle loaned on a basis that may be equitable or patronage-based; APP II.10 lists references to examples in Botswana, Kenya and South Africa as well as Ethiopia. Among camel-herding cultures, too, impoverished relatives are lent camels, with the advantage of shifting the burden of maintenance and protection (Dahl and Hjort 1984:146, Gauthier-Pilters and Dagg 1981:81, Spencer 1973:37-40). Lending may have been an already-established system by the time cattle were first used for working in the Ancient Near East, as there is a good economic rationale to long-term lending of cattle (Bogucki 1993:499), such as keeping up relationships, dealing with labour shortages and distributing the herd to buffer against risks such as theft, disease and grazing shortages (Russell 1998:45).

Philip (2001:187) suggests that kinship and other links between households may have been key paths in the southern Levant Bronze Age to plough animal access and therefore to timely agricultural work; Peters (1986:139) supports this hypothesis from a study in Botswana. There is inevitably a blurring between lending and hiring at this point, as the borrower has incurred an obligation which might in future involve supplying labour; Farnham (1997:102-4) reports that in north Togo most ox-owners had at some point lost animals and borrowed from neighbours, at no charge but with the knowledge that a favour would be returned: such lending of oxen for free was explicitly seen as 'an insurance measure' (Farnham 1997:110). Inequality may emerge temporarily in the early stages of adoption, as described by Vall *et al.* (2002b:125) in a village in northern Cameroon where the introduction of traction animals produced a classic hierarchy of wealth-accumulating owners, renters unable to earn sufficient to buy because of a shortage of available land, and young hired labourers aiming to climb the ladder; the authors then contrast this with areas in Cameroon with longer-established animal traction, where an equitable system of lending between kin has evolved.

As discussed above, investment in working oxen requires a strategy of employment well beyond the short ploughing season, to offset not only the original outlay but the heavy maintenance costs; in modern Africa modern working-animal overviews and studies indicate that this almost invariably involves hiring out the team (e.g. Blench 1997:15, Long 1986:24, with more examples referenced in APP II.10); Pullen (1992:53) argues that in the Bronze Age Aegean owners may well have hired out their teams to increase their general income potential. Tiffen (1976:128-31) describes insensitive constraints (now abolished) in a region of Nigeria in the mid-20<sup>th</sup> century AD, where farmers were supplied by central authorities with oxen and ploughs but forbidden to hire them out 'lest other farmers should be enabled to cultivate more land without using manure'; there was therefore disappointing uptake as some farmers regarded hiring out of the plough and team as an important factor in acquiring these assets, providing 'a means of obtaining cash to finance the extra weeding that ploughing a larger area of land made necessary'. McCown *et al.* (1979:305) report that some owners in Africa even 'preferred to hire out their animals and cultivate their own farmland with hired labour', and there are even accounts (e.g. Lawrence and Pearson 2002:109) of landless individuals making a living simply from hiring out draught animals. Ox-owners may also hire themselves out with their team, adding to the payback on their animals (see references to examples in APP II.10); in regions where it is not considered suitable for women to

handle oxen – so that they have to buy the owner's handling services in addition unless they have suitable in-house male help – this system is of particular use. Other modern instances of such 'man and van' systems of hiring out an ox-team with its owner are found outside Africa, for example in Georgia (Bradbury 2010:7).

There is little recorded ethnographic material about hiring of vehicles with oxen, though Mofya and Chisenga (2000:128) mention hiring of ox-carts in Zambia. On the 2<sup>nd</sup>-millennium BC Assur-Kaneš long-distance trade route, wagons (drawn by oxen or donkeys) are mentioned and were probably hired as needed for shorter-distance movement of bulky goods (Dercksen 1996:66 – see Chapter VII.2).

### Payment

How is the 'cost' of providing working cattle to others calculated? In Mesopotamia, with its centrally-owned ploughing animals, there are few textual references to cattle hiring or sharing until late in the 3<sup>rd</sup> millennium BC, when for example in a Girsu text plough animals were transferred between households (Heimpel 1995:88). In early 2<sup>nd</sup>-millennium BC texts, Stol (1995:185/191/198-9) records regular references to cattle being hired for threshing/ ploughing/ pulling a wagon, for barley or shekels, including indications that the rental fee was on occasion shared between two people, with co-ownership of an ox. He makes the point (1995:198) that human members of the plough-team are similarly hired, underlining the seasonal nature of ploughing and the occupation elsewhere of humans and animals for the rest of the year; this also adds dimension to the exchange of use of working animals for human labour, common throughout history to today.

In many cases in Africa, as in the examples of Ethiopian ox-hiring cited by Spiess (1994:§4),

most borrowing is based on informal agreements among families and neighbours. They basically help each other and ox owners do not make much "business" from their oxen.

Outside Africa, in modern Georgia,

[n]eighbours are not expected to pay for help, but provide the hay for feed and will aid the oxen owners in other ways such as help with building.  
(Bradbury 2010:7)



If a more formal recompense for the use of ox teams (with or without the owner) in Africa is to be made, it may take the form of labour, cash or produce (APP II.10 lists references); payment may be deferred until after the harvest. Reports are given of between 1 and 5 or more person-days exchanged for an ox-team day (Bogucki 1993:498, Halstead 2014:42, Spiess 1994:§4). Peters (1986:150) notes that in Botswana, outside close kin, only male labour can be exchanged for ox-team hire, presenting female small farmers with a problem as their labour is normally only exchangeable for cash, goods or a share of the harvest. In Tigray in Ethiopia (as well as labour recompense), Spiess (1994:§4) notes payment in cash or with 25-30 percent of the harvest; in one district

some oxenless landowners give the land as well as half of the required seed to the landowner with oxen and in return the landowner collects half of the harvest from the land

while in another, where land is very scarce, payment is in feed for the animals.

Although there is little mention in modern accounts of compensation in case of injury to the animals, several 2<sup>nd</sup>-millennium BC Sumerian and Old Babylonian texts (Roth 1980) demonstrate that laws were in place from ancient times to protect both the hirer and the owner in the event of harm to hired oxen, concerning the degree of liability in various circumstances and the payment for death or injury claims; the Code of Hammurabi also specifies a higher hiring fee for the two front oxen in a multi-pair team, perhaps because they are more highly trained (see Chapter IV.2).

## ***Donkeys***

As discussed in other chapters, there is ample evidence that the different physiological and behavioural characteristics of donkeys and oxen lead to different usage and ownership patterns. Donkeys are lower-maintenance than oxen as they are considerably easier to feed, water, train and keep; their marked weight-carrying ability and ease of handling makes them suitable for a wide range of tasks with only minimal supervision, including by women and children (Chapter VIII.3). It can be suggested that this makes donkeys easier than oxen to own and to employ all year round, without the incentive to hire or lend, but there is nevertheless good ethnographic evidence discussed below of a flourishing system today of hiring, lending and communal ownership of donkeys, including 'contract' use for carrying

others' produce and goods. Texts from antiquity, noted below, also support the hypothesis that the hiring, lending and sharing of donkeys was a central part of the donkey-using industry, enabling wide usage and allowing wealth disparities to be bridged.

As with oxen, both immediate benefit (e.g. grazing and protection from predators (Marshall and Weissbrod 2009:71)) and long-term social benefit can be achieved by lending donkeys. Studies in several African countries demonstrate that donkeys are lent to help relatives and friends or to establish good relationships with neighbours and local groups (APP II.11); Pearson *et al.* (2001:23) report from an Ethiopian study that as a result 'donkey use seems to be part of the social network' in rural areas. Waithanji (2009:34) reports as a practical point from a survey in Kenya that such lending 'is free to discourage further borrowing as paying for the donkey gives the person renting it a sense of entitlement to the donkey'.

Accounts from sub-Saharan Africa underline the common hiring out of donkeys as a valuable source of income (APP II.11 lists a number of example studies and overviews), in cash or for example in a percentage of the product carried. Owners frequently accompany hired-out donkeys, for the advantage of cooperation with a familiar driver but also to protect their asset from damage (Waithanji 2009:8/34). Hiring out provides landless individuals with an income and allows farmers to diversify into non-agricultural work (Nengomasha *et al.* 2000:22, Waithanji 2009:8). In Kenya youths 'hire donkeys from owners on a day-to-day basis for a fee and engage the donkeys in some income-generating activities' (Ochieng 2011:¶6). In Ethiopia it is the wealthier households which hire out equines by the day for pack, especially in urban areas, while poorer households hire themselves out with their equines, transporting goods by cart or pack (Admassu and Shiferaw 2011:27). In a particular large-scale Ethiopian example, Zenebe and Fekade describe donkey-hiring at the huge Yehil Berenda grain market in Addis Ababa, where around 3,000 donkeys are hired out like taxis for transporting the grain purchased at the market (Figure 34):

the donkey operators bring all of their donkeys to the market place as it is difficult to arrange for herding around their residences. Moreover, they do not want to forego business if they happen to get a lot of grain to transport. They can also rent their donkeys to other donkey operators. (Zenebe and Fekade 2004:71)



Figure 34: 'Taxi' donkeys waiting for hire at the Yehil Berenda grain-market, Addis Ababa, Ethiopia (© JG Ethiopia 2014)

In early 20<sup>th</sup>-century AD southern USA an interesting 'quasirental market for mules' developed, in which mules were often sold untrained and with deferred payment, with the mule being trained by the new owner and then either paid for within a year, or returned without payment but trained (Kauffman 1993:342). This system also demonstrates the value added to working animals by training. Chivers (1983:34-5) raises the additional subject of hiring out of equids for stud. In 19<sup>th</sup>-century AD Britain, for example, specialist stallion owners toured the country with their animals, and stallion-hiring cooperatives developed in order to make best use of the hiring cost.

The hiring out of caravan animals is mentioned in the 2<sup>nd</sup>-millennium BC Kaneš texts concerning the pack trade between Anatolia and Aššur (Dercksen 1996:67); new animals, too, were required *en route* when donkeys fell ill, died or were stolen or strayed, and Dercksen (2004:261-3) suggests that there may have been established local businesses hiring out donkeys for a stretch of the route, sometimes with a driver, and reclaiming the animals at the next town. In modern Lapland, Ingold (1980:251) reports Lapps and Finnish pioneers hiring out reindeer teams for draught, sometimes hiring themselves out with their teams and carrying merchandise on certain routes. Modern reindeer herders may deliberately not allow some of their reindeer to bond with individual humans as they would then not be able to sell or hire them out commercially for work, though they do nevertheless sometimes lend or give these animals to others (Ingold 1980:172). Several authors

comment on the greater tendency for donkeys than oxen to bond with their human keepers (e.g. Jones 2004:198).

A text from 2<sup>nd</sup>-millennium BC Deir el-Medina in Egypt suggests donkeys being hired out *ad hoc* for a few days, with the owner perhaps taking the donkey back home for the night (Janssen 2005:11). Janssen (2005:110) and Janssen *et al.* (2003:26-7/44) report on a puzzle in several Deir el-Medina texts in which woodcutters (and also water-carriers, doorkeepers, policemen, a fisherman and a potter) hire donkeys from workmen, sometimes for only a few days and at high rates. The commentators' suggestion is that these recorded instances are in fact exceptions – as woodcutters and water-carriers have frequent need of transport – and that donkeys are normally obtained from elsewhere, perhaps from a communal pool. Communal ownership of a 'pool' of donkeys might be more successful than communal oxen, as donkeys can often be left to forage for themselves and are less subject to theft, as they are less in demand than oxen for meat (Chapters IV.2 and VI.1); need, too, is generally more year-round (Chapter V.5). As noted elsewhere, pastoralists in Africa habitually recruit donkeys *ad hoc* from semi-wild groups when moving camp (Chapters IV.2, VI.2 and VII.1, and APP II.14). In modern Africa, Fernando and Starkey (2004:20) give an example of a donkey owned collectively by three women in Kenya, which they used for collecting water, gaining income by hiring to others, and transporting grain and soda ash for trading. However, Blench *et al.* (2004:217) give a lively account of the demise of communal donkey 'ownership' in Nigeria:

[i]n northern Borno State it was said that, until the 1950s, donkeys were semi-feral and were allowed to graze freely by rivers. Individuals who needed pack animals captured the wild donkeys, trained them, and sent them back to the river when they were not needed. As the taste for donkey meat developed thieves came from outside and loaded all the feral donkeys into trailers and sent them for slaughter. This created a shortage, and farmers who previously had considered donkeys a free resource were now obliged to buy them and to tether them in order to discourage thieves.

### ***Implications for early use of working animals***

Hiring, lending and sharing is commonly reported as a key component of modern systems of working animal operation in Africa and elsewhere, supporting the textual evidence on oxen from the early 2<sup>nd</sup> millennium BC and suggesting that it is valid to speculate on such circulation of animals in the private sector in the 3<sup>rd</sup> millennium

BC. A wide spectrum of arrangements for temporary usage of working animals is habitually used today; these strong and self-generating levelling mechanisms, where present, enable maintenance of a minimum practical resource of working animals within a community.

As discussed in Chapter V.5 and suggested in my research aims (Chapter I.1), robust ethnographic evidence demonstrates that, in an adjustment to traditional archaeological models of ox-ploughing adoption, the economic importance of year-round team utilisation levels is at least as much a driver for hiring out as is demand from non-owners; modern models indicate that insufficient attention may have been paid to the fixed-cost burden of working ox management such as training, husbandry and foddering, and to the variety of strategies required to provide return on investment. Evidence shows that these include a typical continual shift between ownership and hiring-in of ox-teams, according to changing individual circumstances.

Communal ownership of working cattle has generally had less success in modern times than kinship group arrangements, which may have developed in antiquity; in contrast, communal systems are often well-suited to donkeys due to their very different physiology and behavioural patterns. Systems used in Africa and elsewhere today, by both sedentary and nomadic groups, such as recruiting working donkeys *ad hoc* from a semi-wild 'pool' (see Chapters IV.2 and VII.1), may have ancient origins and contribute to the comparative invisibility of the working donkey.

More formal hiring out of donkeys is also very commonly noted in modern African studies; a key driver for this is income generation, through the wide potential for transporting goods for sale and sub-contracting to others with transportation needs. The main factors contributing to the contrast with plough-ox systems are the low maintenance and multi-use capabilities of the donkey (see Chapters VI.1, VII.1 and VIII.1); appreciation of these key differentiators may assist materially in establishing the likely differences in systems for operation of these two animals in the periods of their early systematic use.

## VII BEYOND PLOUGHING

### VII.1 Donkeys for short-distance transport

#### *Introduction*

The lowly but central role of short-distance transfer of food and household goods has been largely neglected in Ancient Near Eastern archaeological commentary (Wright 1969:58), and I address this element in my research aims (Chapter I.1). Local transportation, if mentioned, is too often associated with the wheel (APP II.20), betraying a modern Western bias and possibly preconceptions from analogy with the 4<sup>th</sup>-millennium BC development of ox-carts in the Central Asian steppes (see Chapter II.1). As noted in Chapter VII.2 on carts, if donkeys are available pack transport may often be more practical than wheeled vehicles. Oxen employed for ploughing can in theory be used for on-farm pack work, but they are ill-suited for this task compared with their value for pulling vehicles and implements (e.g. Köpp 2013:110, Margueron 1989:121). Cattle can carry much less per liveweight than donkeys, particularly in difficult terrain (e.g. Digard 1982:138-9), as they have poor stability and balance; unlike donkeys, they may require a fit adult handler. As reported in surveys of economic choices in draught animal use in modern African and Greek regions (APP II.20), modern farmers may prefer to use donkeys, with or without small donkey-carts, rather than employing cumbersome ox-wagons.

Donkeys in modern developing regions typically perform the roles of bicycles, wheelbarrows or light motorbikes (Yousef and Dill 1969:682, Starkey 1998c:21); in modern China, in the arid Zhangye Prefecture in Gansu Province, the donkey is called 'the farmer's jeep' (Tibbs 1989:64). Van Dijk provides a useful summary of how donkeys are typically used for short-distance transport:

- Providing primary source of income through direct use by transporting people and goods. Many landless people use their working animals to provide their main source of income because it is seen as a more reliable source of income than alternatives such as daily wage labour.
- Supporting agriculture activities such as transporting feed/water for livestock, cultivation activities such as ploughing and providing essential access to markets by transportation of agricultural products.
- Reducing the labour and drudgery of daily domestic household tasks such as collection of water and firewood especially for women and elderly. The use of working animals reduces the time spent on domestic

activities and provides an opportunity for income-generation by women.  
(van Dijk 2011:¶1)

Short-distance transport is defined for this thesis as centric, with the transporter (human or animal) returning to base, typically daily. The definition applies to the activity not the animal, as a given donkey may be used for both long- and short-distance work: off-duty caravan donkeys might be used for local transport, and modern mobile pastoralists in regions of Africa use donkeys for both local forays, to exchange goods and acquire foodstuffs, fuel and water, as well as for long-distance trade and to carry household goods and equipment during moves (APP II.20). The camel-owning Tuareg, for instance, reserve their camels for long journeys and prefer to use donkeys (rounded up *ad hoc* from semi-wild groups (see Glossary)) for short trips (Johnson 1969:141), as today a pick-up truck would be chosen instead of a large van.

### ***Origins of short-distance donkey-transport***

The use of donkeys for short-distance transport outside their indigenous regions may have stemmed from the reuse of pack-caravan donkeys or those used by nomadic groups, perhaps those left in passing at settlements as today following injury, illness or giving birth (see Chapter IV.1). Donkeys might also have been brought by local traders and messengers returning from exchange points. Kreike (2010:95-8) reports how in north-central Namibia in the 20<sup>th</sup> century AD donkeys were initially brought in by returning migrant workers using them for transport of food and goods, and were subsequently imported in large numbers for their usefulness despite colonial disapproval; they then became increasingly adopted for ploughing as an alternative to cattle, which may suggest a pattern for the adoption of donkeys for farm-work in Mesopotamia. Bulliet discusses how nomadic Arab camel-breeders found short-distance transport work more lucrative than supplying camels for long-distance caravans:

[t]here was a natural limit to how many camels could be utilized in long distance caravan trade and how much money earned, but there was virtually no limit to the economic potential of using the camel for humbler transport duties once the nomad and his animal became acceptable to settled society. (Bulliet 1975:109)

The steady but flexible demand for transport animals for short-distance work – regular farm and household activities, *ad hoc* larger tasks – may also suit breeders more than the heavy but less frequent business of supplying long-distance caravans. From the user point of view, there are few entry barriers to short-distance donkey transport except a short training period: donkeys can use human paths or tread their own route, and can carry sacks directly on the back or baskets slung with cords (Chapter VII.3). Issues of feeding and work organisation are much less significant than with long-distance animals: typically donkeys are left to browse locally and recruited as needed for work (Chapter VI.1).

Donkeys used today for ploughing in practice spend the majority of their time on farm or household transportation tasks, as reported in sub-Saharan African surveys (e.g. Aganga and Seabo 2004:156, Barrett *et al.* 1982:6, Pearson *et al.* 2001:20). This suggests that the teams of donkeys described in a range of mid to late 3<sup>rd</sup>-millennium BC Mesopotamian texts as used for agricultural purposes (see Chapter II.1, and APP II.21) are very likely to have been employed for short-distance transport as well as ploughing. Zarins (2014:189) points out that the 'plough' sign in the Uruk IVa Archaic texts (see Chapter II.2) may sometimes denote farm-work generally, rather than solely ploughing, just as now a tractor image often stands generally for farming.

### ***Short-distance donkey transportation benefits***

Short-distance transport in villages and farms in the modern developing world is widely recognised as time-consuming and burdensome, in year-round terms far exceeding that of agricultural fieldwork (e.g. Anderson and Dennis 1994:378/381, and see the Waithanji 2014 survey below). Studies of transportation activity in villages in Tanzania and Ghana, employing the tonne-km measure (effort involved in moving one tonne one kilometre), demonstrated that three-quarters of the annual transportation effort occurred within the village; water, firewood and crops to the grinding-mill were the main activities, with water accounting for 70% of the tonnage, women taking the majority of the burden, and the processes taking up to four hours daily (Doran 1994:272-3). Bogucki (1993:498) underlines for example the time-consuming daily process of collecting fuel, perhaps underestimated by archaeologists more familiar with temperate, forested regions. Nengomasha *et al.* (2000:26) report too from a farming study in a region of Ethiopia that 'pack animals



offered the only realistic way of obtaining returns from agriculture above mere subsistence'.



*Figure 35: Girl carrying water, Warkamla, western Ethiopia (© JG Ethiopia 2014)*

The carrying of burdens is the traditional role of women in many cultures (APP II.5; see Figure 35). The physical, economic and social benefits for such women of the adoption of donkeys for short-distance transport are summarised in Chapter VIII.3, including reduced reproductive and medical problems (APP II.5) and potentially new opportunities for productive and income-earning work. As noted in Chapter VIII.3, there are numerous accounts in analyses of working-animal adoption in sub-Saharan Africa of cultural constraints upon women of use of cattle; in an interesting side-light, in Uganda men are reported to be more willing to do 'female' work such as transportation of farm produce now that donkeys can do the carrying (Ayo-Odongo *et al.* 2000:212). Occasional barriers are reported, as in some West African societies where women have access to donkeys but still carry fuel or water

themselves (APP II.5); the underlying reason may in fact be economic, as reported by Doran (1994:275): '[h]ouseholds had to choose between conserving the energy of their animals or that of their women; in many cases the choice favoured the animals'. However, the common delegation to children and youths to lead the donkeys (APP II.5 and Chapter VIII.3) can free significant daily time for women to take on other useful tasks.

Transporting goods for others by donkey is commonly reported in studies of developing regions today as an important source of income (APP II.7), particularly for women and other landless and disenfranchised individuals, but also for farmers aiming to maximise working-animal utilisation in slack seasons, with donkeys seen as productive assets in the same category as land and other holdings (Pritchard 2014:3). Firewood and water – crucial to daily life – are commonly transported by donkey for financial gain in modern Africa and elsewhere (APP II.7); this trade is likely to have ancient antecedents, as instanced by the common association of donkeys with water-carriers and woodcutters in the texts from 2<sup>nd</sup>-millennium BC Deir el-Medina in Egypt (APP II.20). Payment for transport services is often in kind, as in antiquity, including repayment of obligations or storing up of goodwill (Chapter VI.2). Much direct commercial activity still often lies in the hands of males (APP II.7); but a little-mentioned further economic consequence of new transport capabilities is the increased capability – for women in particular – for production of marketable goods (pottery, farm-produced beer) and for transport to market for sale (JG Burkina Faso 2013, Zaman *et al.* (Zaman, Upjohn and Valette) 2014:159). Chapter VIII.3 underlines, though, that any application of analogy with ancient Mesopotamia should not go further than the initial assumption of reduced human load-carrying, with only limited clues so far as to the consequent direction of redeployment of labour.

### ***Short-distance transport in urban contexts***

The relationship between agriculture and urbanisation, notably in 4<sup>th</sup>-millennium BC Mesopotamia, is commonly discussed in terms of plough agriculture as an enabler of crop surpluses, whether as a cause of population growth or an effect (Chapter V.5). Some separate references occur to the importance of long-distance transport for the growth of complex societies and cities (e.g. Zarins 2014:198), but few focus

on the contribution of short-distance transportation to the day-to-day logistics of supporting an urban population.

Transport from field to farm and to consumption location was always available in human form, as for Mesoamerican cities (Hassig 1985:132, McShane and Tarr 2007:179), but models of surplus-provision rarely address the practicalities of dealing with the major increase in bulk for transfer from the hinterland to newly urbanised nodes. Branting (2010:51-7) describes detailed models for 'pedestrian transportation simulations' (p53) applied to 1<sup>st</sup>-millennium BC Kerkenes Dağ, for analysis of urban movement patterns such as bulk grain import; the models go down to the level of human stride length and pedestrian age, sex and footwear, but the operation of a similar system for animal transport is only mentioned in passing. Reference to short-distance transport into urban areas is generally to agricultural products; Branting (p55), with Bairoch (188:13-15), is unusual in mentioning firewood and water transport, and Bairoch adds construction materials; these are key items conveyed year-round into urban areas in modern developing countries. In a census of donkey and human transportation in and out of Kano in Nigeria (Robinson 1977:13), donkeys' main burdens were firewood inwards and dung out to the fields. Accounts of 19<sup>th</sup>-20<sup>th</sup> century AD urban equids in the United States and Britain underline the problem of dung removal (APP II.20); it may be collected by farmers in return for fodder supplies (Hering and Greeley 1921:576, Thompson 1983:62), which are in themselves a major issue for urban working animals (Chapter VI.1). There is no direct Western-world parallel as the waste from fuel entering in vehicle petrol-tanks is emitted as exhaust gases; in its place is the major outward flow of household and industrial 'rubbish' for landfill, a concept hardly known in antiquity.

In modern developing regions, use of donkeys in urban and peri-urban areas is commonly intensive and potentially lucrative (APP II.20), for transport of grain, firewood, water, construction materials and fodder; this is a useful occupation for landless individuals (Nengomasha *et al.* 2000:22, Pearson *et al.* 2001:17). In modern Ethiopia '[a] large part of the people and of the economy of Addis Ababa depends on donkey transport for the movement of grain from wholesale centres to retail outlets and households' (Zenebe and Fekade 2004:69), with several thousand donkeys employed daily at the vast Yehil Berenda grain-market (APP II.20; Figure 36). There is evidence in modern times of a gender division; accounts from present-day Iraq, Kenya and Ethiopia indicate that pack donkeys are managed mainly by

men in urban areas (for commercial gain) and by women in rural areas (with less direct income gain) (APP II.20), though in modern Ethiopia women and children have some hold in the business of urban water-selling (Pearson *et al.* 2001:26).



*Figure 36: Loading 100kg grain-bags in Yehil Berenda grain-market, Addis Ababa (© JG Ethiopia 2014)*

As Vila (1998:5) notes, rather than a specific technological advance it was the broader domestication and manipulation of species that allowed a move from subsistence to a complex economic system. New modes of short-distance transportation to supply large centralised demand might have been a necessary context in which urbanisation flourished (as suggested by commentators listed in APP II.20), albeit not an initiator. Cities then as now became heavily dependent on their supply systems (McShane and Tarr 2007:xi, Zenebe and Fekade 2004:69), with predictability of supply of foodstuffs and raw materials even more crucial than quantity (see Chapter V.4). Analogies between urbanisation in 4<sup>th</sup>-millennium BC Mesopotamia and modern situations are necessarily tentative and must rely on the resilience of basic forces; but insufficient attention has been paid to the practical workings of modern major cities. Tarr encapsulates the inescapable need of cities for local essential supply systems:

[o]ne way to think about cities is to conceptualize them as energy systems — as entities that require flows of energy for a wide range of purposes including heat, light, and power. Over time, the sources of these energy

flows have changed from human to animal power, and then to steam, electricity, and gas. (Tarr 1999:434)

### ***Marginal land***

The issue of travel and transportation to and from marginal land, or around large farms, is touched upon in Chapter V.5. The nucleated settlements and large centralised farms of 3<sup>rd</sup>-millennium BC Mesopotamia presumably raised the issue of a farm-to-field transportation system (Halstead 1989:77, 1990:189), perhaps resolved through working animals. Oates and Oates (1976:120) record from observation in modern Mesopotamia that farmworkers will not walk more than about 7 kilometres to the fields daily; Robinson (1977:10) reports a general maximum in Africa of 5 kilometres, with Hassan (1993:556) also suggesting this figure for ancient Egypt in the absence of donkey transport; Brodie (2008:302-3) posits decreasing returns beyond c.3 kilometres in the Early Bronze Age Aegean. While walking such distances daily is nevertheless common in many developing regions, for example if there are security dangers in living outside settlements (McCann 1995:104), it implies loss of working time at least. Isaakidou (2008:104) suggests that adoption of draught cattle at Knossos was generated by a need to carry manure to more distant fields as the crop-using population grew; Brodie (2008:302-3) argues that the Bronze Age population growth in the main settlement on the Greek island of Melos could only have been achieved by 'an agricultural system that relied on animals for transport', allowing the use of distant fields, and that the transport animals could reasonably be assumed to be donkeys. He continues

once it had become viable to farm larger areas of land at locations further removed from settlements, residential options multiplied... [allowing] flexibility of choice in both settlement location and degree of household aggregation. (Brodie 2008:304)

As well as social decisions, economic factors were affected, as farmers would then be freed to choose field locations for reasons other than proximity: Hassig (1985:264) records about Conquistador-period Mexico that with the advent of animal transport '[a]reas of agricultural exploitation developed with more concern for favorable production than for transportation ease.'

The issue of location of cultivable fields, in the face of population growth or drought, is regularly aired in modern Africa and elsewhere. In western Uganda, for example,

[i]ncreasing human population and the resultant pressure on land has forced many farm families to cultivate in distant places far removed from homesteads where there is relatively abundant free land... [resulting in] failure to quickly transport harvested crops to places of storage and or markets. Consequently high post-harvest crop losses were experienced through vermin, rain, mouldiness or aflatoxins, theft, termite damage and spillage. (Ayo-Odongo *et al.* 2000:211)

This problem was solved by the introduction of the donkey for speedy transport of crops to storage and markets. In northern Namibia, drought conditions have been leading to greater distances between viable pasture for grazing cattle and available land for cultivation, leading to an increase in use of donkeys for ploughing as they can forage successfully near to the arid fields (Haufiku *et al.* 2004:176). Admassu and Shiferaw (2011:51) describe how in urbanising areas in modern Ethiopia, the increasing shortage of grazing and of spare land for fodder-growing has resulted in supplementary feed such as crop residue being brought in by donkey to feed work oxen and other livestock (with the donkeys themselves being last to receive any remaining feed). Clark and Haswell (1970:209) report on a survey of African road expansion that '[e]ach kilometer of road built ... has the effect of opening some 60 ha of new agricultural land' and of raising gross agricultural production permanently, albeit potentially at the expense of production elsewhere.

### ***Items carried short-distance***

Items carried locally vary according to conditions: in dry zones, water and firewood is transported for longer distances, while more rainfall increases the volume of agricultural produce to be carried (Doran 1994:274); the use of animals for ploughing in itself increases the agricultural load to be conveyed (e.g. Lubumbe 1994:366). The carrying of firewood and water, though, is the overwhelming mainstay of short-distance donkey use in sub-Saharan Africa, mentioned more often in modern studies than any other task; APP II.7 lists references to all items mentioned as carried short-distance in the many modern studies and overviews examined for this thesis. The use of donkeys for transport of crops from the field for threshing, storage or selling is also ubiquitous; the speedier transport to storage or market reduces the risk of vermin, animal and human theft, insect and mould damage (APP II.7), so farmers without transport may find it worth their while to pay for carriage (e.g. Barrett *et al.* 1982:52). Epstein (1985:59) describes late 4<sup>th</sup>-millennium BC southern Levant figurines of donkeys with 'panniers for olives, pulses

and fruit, large pottery bins and jars for grain' for bringing in the crops (Figure 37 and see Chapter VII.3 on pack containers generally). However, transportation of crops is very seasonal (Anderson and Dennis 1994:381, Bogucki 1993:498).



*Figure 37: EBA donkey figurine from Azor, Israel (9.5cm h x 7cm l) (© Israel Antiquities Authority, by permission)*

The importance of fodder for working animals is discussed in Chapter VI.1, and donkey transportation of crop residue and specialist fodder is common in modern times (APP II.7, and Figure 38). Improved transportation of crop residue has a material effect on the success of maintaining hard-working ploughing animal condition (Starkey 1994a:76), and crop residue such as chaff is also used in ceramics and construction materials (Charles 1990:55). Ox-wagons are suggested for transport of crop residue and fodder transport in antiquity (Astour 1995:1402, Bogucki 1993:498), and are indeed used in some regions (e.g. Kjaerby 1983:27), as are sledges (Isaakidou 2011:103), though both have considerably less flexibility of use (see Chapter VII.2).





*Figure 38: Donkeys transporting straw in Addis Ababa, Ethiopia (© Noah Snyder-Mackler 2010, by permission)*

Dung – a heavy load to carry – is a common burden for donkeys, from fields to farms or from compounds to fields, for fertilising or for fuel or building (APP II.7 in the list of items commonly carried short-distance by donkeys), taking advantage of lulls in other work (Halstead 2014:213). Manure is also exported from urban areas, as noted above. The modern equivalent, fertiliser, is also commonly transported by donkeys from distribution centres and to the fields (APP II.7), allowing more intensive farming and use of more distant plots (Sieber 2004:119); Starkey (2011:11) describes how '[w]ork animals create synergy in nutrient cycles, farming and marketing systems', helping to circulate manure and the resulting harvest.

Donkeys are very widely used in modern Africa, by sedentary and mobile groups, for the transport of items for sale at markets (farm produce, products gathered from the countryside, and manufactured items such as pottery and beer), and for carrying purchases home from market (see APP II.7 for a wide range of examples from studies in sub-Saharan Africa and elsewhere). Liverani (2006:44) argues for the existence of local markets in Mesopotamia below the purview of the recording authorities, for household-level exchange of agricultural produce and for example pottery. The use of donkeys allows access to more distant markets and



transportation of heavy and bulky goods (e.g. Robinson 1977:10); Pearson *et al.* (2001:2) report from Ethiopian studies that 'farmers with a cart or pack animal can get a higher price for their goods' as they can respond more flexibly to demand. This results in new goods exchange nodes, as with the Ethiopian Yehil Berenda grain-market mentioned earlier; this escalates into another process, unsung in archaeology until recently but now increasingly acknowledged, of the feeder-supply of goods to 'railheads' – ports, collection points for long-distance caravans.

Gebreab (1992:104) gives an example of 21<sup>st</sup>-century AD systems in Ethiopia:

[e]quine based transportation provides movement of both capillary and arterial nature. Goods can be collected at the smallest hamlet and brought to a market or central depot facilitating both economy and reliability.

Waithanji (2014:2) reports from a survey in Kenya that the greatest contribution of working equids is

hauling produce through the "first mile" of the logistical journey of the value chain. The first mile is constituted by the distance between the point of production and the point of efficient transportation using vehicles travelling on all weather roads to the consumer markets. In parts of Kenya, the first mile has been established to be about 1.5 to 13 km, which constitutes 0.4% to 10.6% of the entire logistical chain.... The study also revealed that 20-37% of all transport costs are expended in the first mile. ... Women, more than men, tend to be concentrated at this first mile, which constitutes part of the bottom of the value chain where labor intensity is high and capital demands low. At this point too, 30-60% and sometimes, even 100% of post harvest losses due to transport challenges are documented.



*Figure 39: Carrying bricks in India (© Donkey Sanctuary 2002, by permission)*

Another factor under-discussed in archaeological literature is the impact of working animals on transport of raw materials, especially construction materials: a change of material, or change of source, might give an indication of animal transportation, as in 4<sup>th</sup>-millennium BC Europe where an increase in use of heavier timbers and other house-building materials became apparent (Pétrequin *et al.* 2006a:11). The use of off-duty ploughing oxen for transporting building materials in late 1<sup>st</sup> millennium BC Greece (Isager and Skydsgaard 1992:104) is commented on in Chapter V.5. Ethnographic accounts of donkeys in Africa and Asia commonly report the transportation of construction materials (mud, dung, grass, sand, stones, poles, straw, bricks) for building or repairing housing and other structures (APP II.7, and Figure 39), sometimes for income (e.g. Barrett *et al.* 1982:52); soil also needs to be

moved from excavations for irrigation etc. As proposed in Chapter II.2, pastoralists may well have been early adopters of donkeys in Africa, for carrying dwellings (especially the vital poles), furnishings and household possessions during their seasonal moves (APP II.7). In arid regions timber in particular, aside from use for fuel, is also carefully collected, curated and re-used, for building, boats, equipment such as looms, and agricultural implements and tools, while donkeys also commonly carry the implements themselves, to and from fields and workplaces (APP II.7).

Clay, ore, charcoal, wool and flax are further examples of heavy or bulky raw materials requiring transport to manufacturing centres (APP II.7). A dispersion of manufacturing sites, for example further from sources of raw materials and more convenient for onward transport, might indicate an improved transport technology, as with the development and organisation of copper-working in the Negev in the southern Levant from the late 4<sup>th</sup> millennium BC (APP II.22), and in a similar era and region the location of linen-production centres in semi-arid zones unsuitable for flax cultivation or processing (Levy 2011). Refuse also comes into the 'materials' category: the concept of 'rubbish' is a modern Western one, and in developing countries even items not recycled in the household are sorted and reallocated, particularly in urban areas, by specialist collectors such as the Zabbalin in Cairo and marginal groups in Amman (Fahmy 1997:238, Carol Palmer pers. comm. 2015), and commonly transported for use or sale by donkeys (APP II.7).

While this study excludes discussion of riding, the transportation of people and animals (young, infirm or dead) also qualifies as short-distance transport. Donkeys are used by pastoralists in their seasonal moves to transport the young, the old and the disabled, and in both sedentary and mobile communities to carry the sick or injured to where they can be treated, as well as bodies for burial (APP II.7). The adoption of distant burial centres might give indications of the adoption of animal transport, as in late 4<sup>th</sup>-millennium BC in the northern Negev (noted above as an early location of donkey use) where burials took place in caves and at hilltop cemeteries (see APP II.22 for references from Levy and Joffe). Injured or young animals are also transported by donkey, plus small stock such as chickens, and carcasses are carried by working animals from the hunt or slaughter (APP II.7).

### ***Implications for early use of working animals***

Employment for short-distance pack is likely to have operated from the start of human relationships with donkeys, but is left unmentioned in many accounts of systematic use, and it is among my research aims to rectify this. The advent of ploughing and its social and economic implications are instead highlighted; yet in modern developing regions ploughing donkeys – well-evidenced in texts as present in 3<sup>rd</sup>-millennium BC Mesopotamia – are universally employed in addition for short-distance transport as an essential part of their year-round return on investment. Speedy transport of crops from the field to storage, processing or market has a marked economic effect as it hugely reduces harvest loss from decay, pests and theft; heavy implements and manure can be transported to distant fields, and bulky fodder to farmyard animals. Raw materials (ore, clay) and construction materials can be conveyed further and in much greater quantities, altering the parameters for their sourcing and for manufacturing and construction sites.

Short-distance transport has also been central to the operation of cities, from their earliest development. An agricultural surplus – considered a key concomitant factor to urbanisation – requires significant transportation facilities to local storage facilities and in from the hinterland, while the transport patterns of cities in present-day developing regions highlight the major daily inward traffic of firewood and construction materials, and for example of water often being drawn from sources in the city periphery and distributed locally.

As discussed in Chapter VIII.3, household use of donkeys for the daily transport of fuel and water and of goods from market transforms the lives of women in particular, not only in relieving them of heavy burdens (with corresponding health improvements) but in providing free time for making goods to sell. The lowly status of donkeys, and their ease of use and low maintenance (Chapter III.1), permits their use by both women and the landless for income-earning, by taking goods to market to sell, carrying goods for others, and hiring out their donkeys.

## VII.2 Other uses of working cattle and donkeys

### Carts

Working animals are not necessarily a prerequisite for carts/ wagons or sledges (APP II.18 lists sources on human traction), but their systematic use is generally associated with traction animals. (For brevity I use 'cart' for two-wheeled vehicles, and 'wagon' for four-wheeled versions). The development and diffusion of wheeled vehicles in the late 4<sup>th</sup> millennium BC in the Near East and Europe have formed the subject of vigorous pre- and post-Sherratt debate (APP II.18); this thesis does not aim to contribute to this, particularly as there are technological obstacles to comparison with modern ethnographic examples. The paragraphs below provide a summary for general context.

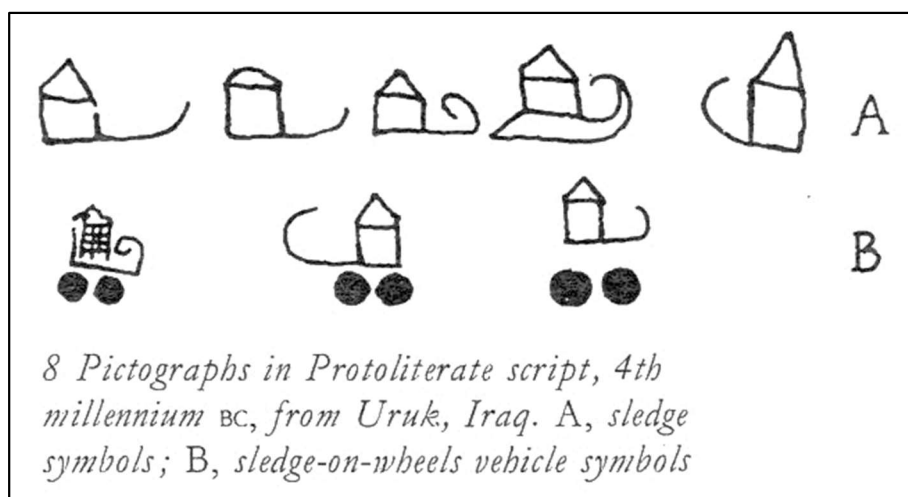


Figure 40: Pictographs on clay tablets from Eanna IVa at Uruk-Warka, showing possible sledges and wagons (Piggott 1983:38, fig.8; © Thames and Hudson, by permission)

Claims for models and traces of wheels from the 4<sup>th</sup> and early 3<sup>rd</sup> millennia BC in Mesopotamia and Europe are sometimes debatable (commentators are noted in APP II.18), and Sherratt (2006:333) takes a robust view on excluding precisely-dated artefacts of dubious purpose and poorly-dated sites of clear purpose. The iconic Mesopotamian Eanna IVa pictographs (c.3200-3100BC; Figure 40) show sledges and possible wagons, sledge-like but with two discs on the side view, perhaps indicating wheels (APP II.18), though Bakker *et al.* (1999:788) suggest that these are captive rollers. A point against the possible evolution of wheeled vehicles from sledges (APP II.18) is that sledges and travois seem normally to have been

pulled by simple cords/ traces (Bakker *et al.* 1999:787), while wagons and carts are depicted, from Uruk times, as being drawn by pole and yoke as with ploughs.

Mesopotamian 3<sup>rd</sup>-millennium BC evidence of wheeled vehicles is patchy (APP II.18), though by the mid 3<sup>rd</sup> millennium BC seal impressions and texts from Tell Beydar and Ebla feature elite wagons. The 2<sup>nd</sup>-millennium BC ruler Hammurabi's remark to the ambassadors from Zimri-Lin in a Mari text, that boats were the strength of South Mesopotamia and donkeys and wagons of the North (APP II.18), may be an over-simplification; but vehicle use in the south may have been constrained by the marshes and canal network (Harriet Crawford pers. comm. 2013, Oates 2001:281). Wheeled transport in antiquity was not suited to competing on long-distance work with river-boats or pack caravans (APP II.18); Dercksen (1996:64-66) records a few references to wagons in the Kaneš texts, but seemingly for onward transport of goods on arrival in Anatolia by pack-donkey caravan, as with the local porters also used (Chapter VII.3). Civil (1994:93) notes that '[t]he wagon is not frequent in Ur III and OB agricultural texts', and suggests for example that the recommendation for a wagon for farm work in line 92 of the 2<sup>nd</sup>-millennium BC *Farmer's Instructions* (Black *et al.* 1998-2006d) relates to an ideal rather than to common practice in Sumer.

As outlined in Chapter II.1, Sherratt based his original traction 'complex' model (1981:263) on a linkage of plough and cart technology, taking an analogy from use of ox-carts for household moves in the northern steppes. He subsequently discarded this parallel: '[w]heeled vehicles may initially have been principally for 'ritual' use (transport of important people)' (Sherratt 2003:243). Early wagons may have been represented as part of a power and status display on monuments and in burials, but in practice little-used for everyday load-carrying (APP II.18); nevertheless, even senior commentators on Mesopotamia still commonly refer unquestioningly to carts rather than local pack (see Chapter II.1). Matuschik (2006:291) notes that while in Europe archaeological finds indicate that early wheeled vehicles were associated with agriculture, Ancient Near Eastern iconography shows wheeled vehicles linked with power and cult. Wheeled vehicle construction is complex (Anthony 2007:65), needing suitable timber, and investment in road infrastructure is generally required (Pournelle 2003:56, Ruoff 2006:137, Vosteen 2006:239-44). The value of carts versus pack or human portage therefore depends largely on the terrain and road conditions (APP II.18) as well as on capacity for investment in a vehicle. In some regions of Africa carts and wagons

have been supplied (on a subsidised basis) by external organisations (APP II.18 and Figure 41); their greater load capacity (APP II.18) provides advantages, but pack donkeys can offer a more flexible resource on the farm and in remote areas, as can travois and sledges, which are widely used in southern and eastern Africa (see Figure 44 and below in the paragraphs on sledges).



*Figure 41: Donkey-carts, Hawassa, Ethiopia (© Stephen Blakeway 2010, by permission)*

Analyses of early representations suggest that use of donkeys for traction may have been initially constrained by unsuitable use of harness perhaps designed for cattle; plentiful examples of counter-productive harnessing methods for donkeys persist today, as recorded in a range of modern studies (APP II.18). Littauer ([1983] 2002:9) notes depictions of equids harnessed to wheeled vehicles in early 3<sup>rd</sup>-millennium BC contexts at Tell Agrab and Khafaje; evidence grows from the mid-3<sup>rd</sup> millennium BC (Littauer and Crouwel 1979:23-35, Zarins 2014:197, *pace* Pettinato 1991:113; APP II.18), notably with seal impressions and oblique text evidence from Tell Beydar in northern Syria (e.g. Jans and Bretschneider 1998:158, Sallaberger 1998:173-5). However, text references to equids in association with wheeled vehicles are generally rare (Littauer and Crouwel 1979:27, Zarins 2014:193-4); among the earliest is a mid-3<sup>rd</sup> millennium BC text from Fara (Zarins 2014:195), of a similar period to the depictions on the Standard of Ur and other evidence from the Ur 'royal' burial site. The exact type of equid indicated in depictions and texts is the subject of debate (Chapter II.2); it is generally recognised that those of the mid 3<sup>rd</sup>



millennium BC are donkeys or donkey-hemione hybrids. Inevitably, little can be deduced from elite representations (as noted in references listed in APP II.18) as to the role of cattle or donkeys for traction outside ceremonial occasions. They could be an irrelevance, as if our present culture were to be judged by illustrations of gilded carriages at state occasions, but as Sherratt (1997a:33) points out, 'it is important not to fall into the trap of assuming that 'prestige' equals 'useless for practical purposes'. Littauer and Crouwel (1979:23-35, [1973] 2002:374-5) suggest that equids became more widely used for traction but that traction cattle were still depicted in art and found in elite graves as the traditional though not necessarily day-to-day norm, just as plumed horses may be used today for a hearse.

Debate on the origins of wheeled vehicles includes models of the separate evolution and function of two-wheeled and four-wheeled versions (e.g. Littauer 1979, Sherratt 2006:351, Vosteen 2006:244). Certainly in modern Africa and other developing areas there are regional and cultural variations in type of animal-drawn vehicle, with a notable factor being external influence such as introduction by European settlers (see references in APP II.18). Modern use of oxen for ploughing may sometimes correlate with use of ox-carts (Blench 1997:24, Langdon 1986:290), as transport use of expensive ploughing oxen helps to offset the investment. The relative advantages of oxen and donkeys for traction are discussed in Chapter III.1.

### ***Sledges and travois***

#### Threshing

It is possible that cattle were first used systematically for work in the threshing process (Sherratt 2006:342, adjusting his earlier (1997a:12) suggestion that the plough preceded the sledge). Grain can be stripped manually, or flailed, pounded or scorched (Ataman 1999:215, Russell 1988:41), or trampled by humans or animals, or large stones or rollers used, but threshing-sledges are much more rapid and efficient in producing grain and particularly chaff (chopped straw). Chaff is laborious to cut up manually (Ataman 1999:214), and trampling (even by hoofed animals) does not cut up the straw well enough; chaff is valuable for ceramic and mudbrick temper, animal feed, bedding and fuel (APP II.25), and its advent is visible archaeologically, for example in dung residue (Anderson 2006:311). Accurate chaff-chopping to the correct length is still an issue today (Halstead and Jones 1989:44,



Whittaker 1999:13), with chaff an important element of fodder for working animals in modern rural Greece.

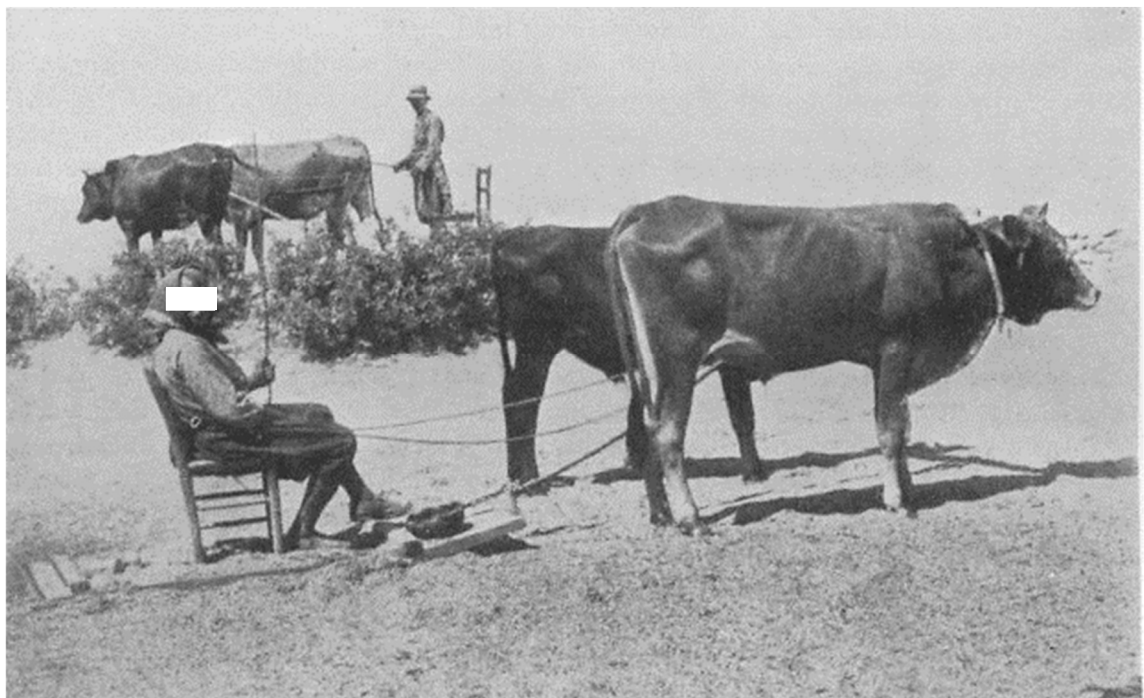
There is growing evidence in Mesopotamia from the 8<sup>th</sup> millennium BC onwards of sledge-based threshing (commentators are listed in APP II.25). Scientific techniques increasingly enlisted in archaeology are providing new early indications of use of animal-pulled threshing-sledges, from animal traction pathologies, microwear on chipped stone used on the underside of threshing sledges, and cutmarks on chopped straw identified in phytoliths (APP II.25), as well as excavation of threshing-floors and associated granaries (Sherratt 2003:249). Evidence of the importance of threshing is underlined by the 4<sup>th</sup>-millennium BC Arslantepe seal impression of an individual apparently seated on a chair on a threshing-sledge (Littauer and Crouwel 1990:15; see Figure 42), which although very possibly ritual is 'surrounded by workers with threshing forks and an animal driver, resembling its use today' (Anderson *et al.* 2006:1560). The development of threshing activity perhaps reflects the new presence of free-threshing cereals (Anderson 2003:434, Anderson 2006:311) or the need to feed animals. Other early traction animal use may have been dogged by lack of expertise in harnessing, but for threshing sledges simple traces tied to cattle horns can be used (Bakker *et al.* 1999:787, Sherratt 2003:249, *pace* Littauer and Crouwel 1979:14). Experiment shows that humans can pull such sledges, but the extra power and weight of animals – notably cattle – and their sharp hooves make a critical difference (Anderson 2006:310, Pétrequin *et al.* (Pétrequin, Pétrequin and Bailly) 2006:362); the benefit of loading the sledge itself, with stones or with humans, is also well-attested in more recent times (e.g. Figure 43), linking with the early ceremonial depictions of humans seated on sledges as noted above.

There is no reason to assume that other threshing technologies became redundant: threshing is done by humans and trampling animals to this day (see references in APP II.25), and the teeth of threshing-sledges may perhaps have been made of (archaeologically-undetectable) wood rather than stone (Civil 1994:95, Littauer and Crouwel 1990:18). Texts and depictions from Hittite Anatolia, Classical Greece and Egypt mention trampling but not sledges (Ataman 1999:215, Isager and Skydsgaard 1992:53, Osborn and Osbornová 1998:135), while in modern times there are distinct regions where threshing-sledges are not used, as in France where rollers and large stones have prevailed despite threshing-sledge use in neighbouring countries (Castel Carpinschi 2003:329-33). Rollers or stones may be preferred in areas

without flint (Sherratt 2006:343, Steensberg 1971:248) or where there is limited need for processing straw. Legumes, for example, also require processing but are as well processed by trampling or flailing as by sledges (Whittaker 1999:13).



*Figure 42: Seal impression from late 4<sup>th</sup>-millennium BC Arslantepe showing an apparent ceremonial threshing-sledge (Littauer and Crouwel 1990:15; © Cambridge University Press, by permission)*



*Figure 43: Threshing in Cyprus pre 1930 AD (Hornell 1930:136)*

Donkeys and cattle are used for threshing up to the present, for trampling or pulling sledges (Brodie 2008:303, Floor 2003:219; Figure 43); one practical note is that

animals transporting crops to and from the threshing-floor are likely to be used for the threshing process. Liverani (2006:17) suggests use of donkeys for threshing in the 4<sup>th</sup> millennium BC, but there is little textual mention until the late 3<sup>rd</sup> millennium BC. This by no means precludes their common usage in practice: in the 3<sup>rd</sup> millennium BC in Egypt donkeys were common threshing animals (Zarins 2014:192). An Ur III text from Umma (BM 111764) records use of donkeys at threshing-floors, and in the early 2<sup>nd</sup> millennium BC Code of Hammurabi, ¶269 refers to hire of a donkey for threshing (Zarins 2014:192).

By the 4<sup>th</sup> millennium BC in Mesopotamia threshing-style sledges appear to have attracted some ceremonial significance, as evidenced by the famous sledge pictographs in the late 4<sup>th</sup>-millennium BC Ur texts (Figure 40), seal impressions from contemporary Arslantepe (Figure 42), and funerary sledges in the Ur and Susa graves of this period (APP II.25). In modern times, Skakun (2003:392) describes the continuing use of threshing-sledges in Syrian burial and wedding ceremonies; Halstead (2014:173-7) describes ceremonies associated with threshing in modern Europe, but highlights the archaeological evidence that workaday threshing was occurring in the fields contemporaneously with the ceremonious threshing-sledge use depicted; he suggests instead that if bureaucracy were involved in the threshing process, it might perhaps have related more to collection at the threshing floor of grain 'tax', as recorded in 2<sup>nd</sup>-millennium BC Greece and more recently in Mediterranean regions (Halstead 2014:177).

#### Sledges and travois for transport

Sledges and (less often) travois are commonly used today in parts of southern and eastern Africa (overviews and descriptions listed in APP II.24, and Figure 44), though they are officially banned in some areas as they are considered to cause erosion (APP II.24). There is some correlation with use of oxen for ploughing – unsurprisingly, given the force needed to pull sledges – and with scarcity of donkey-carts. Sledges are also used in China and the Philippines, and examples are still seen in Europe and the Near East (APP II.24).



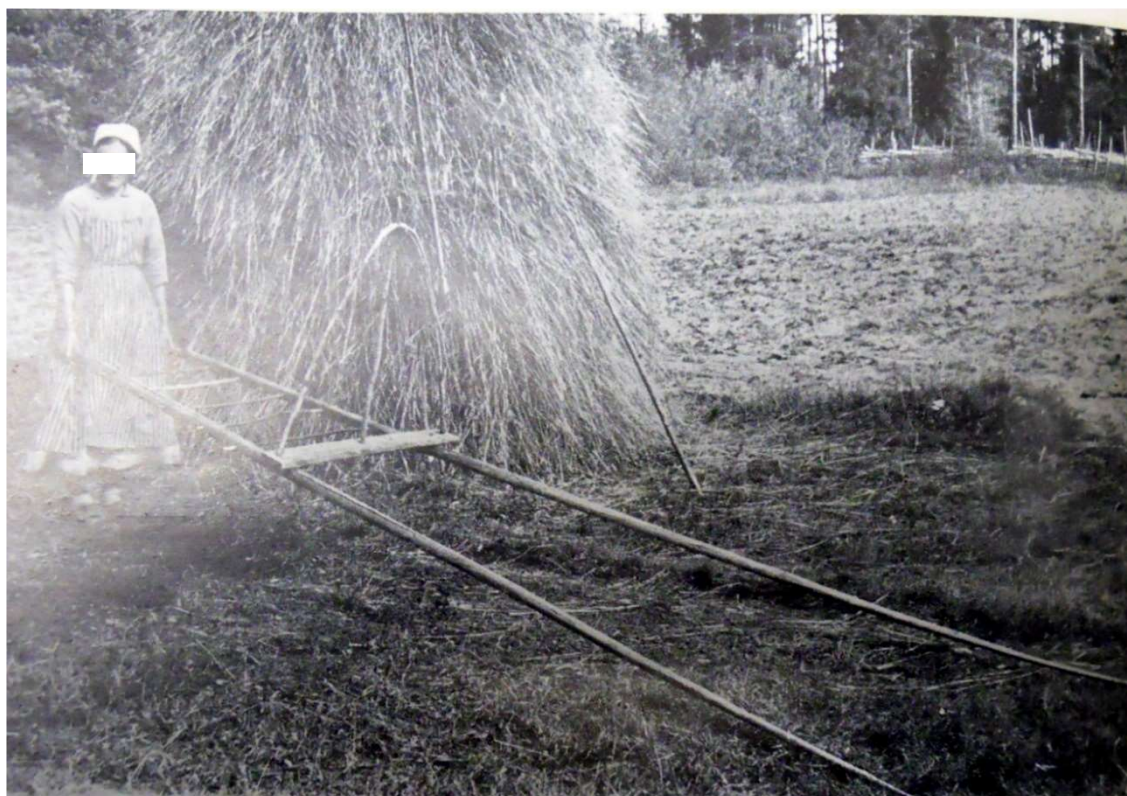
*Figure 44: Ox-drawn basket sledge, South Africa (Starkey et al. (Starkey, Hanekom &c) 2000:104, by permission)*

Travois are a simple construction of crossed poles or branches fastened at the animal's neck and dragged by flexible traces with a load. Unlike sledges, there are no illustrations of or textual references to these in the Ancient Near East (Littauer [1983] 2002:6, Margueron 1989:123), but this may reflect their lowly, rural function. Experiments with newly-adopted working animals may have led to their development: bushes are dragged by animals in modern Africa in a way similar to travois use, and travois-like constructions are used for training traction animals (Mulanda *et al.* 2000:306). The cost of a travois is minimal for owners of working animals: a survey in a region of Tanzania showed that most ox-owners own a travois-like construction of tree-branches (Kilemwa 1999:70).

Sledges and particularly travois can be simply and cheaply made from branches, and elaborated with superstructures and bags/ baskets as needed, and even doubled up for large loads (APP II.24); animal-skins (and nowadays tarpaulins) can also be loaded and dragged. They can be pulled by humans or a range of animals including donkeys, oxen and cows; the pulling is arduous, but there are accounts of 300kg or more being hauled many kilometres by oxen (APP II.24). The working comparison that should be made, pre wheels, is with human and animal pack; sledges and travois were useful and sometimes essential for a range of heavy and



bulky items, notably crops/ fodder, manure, water, ploughs, stone, firewood, as well as the ill and deceased (APP II.24). They are said to be especially valuable in sandy/ dusty regions and on steep slopes (APP II.24); travois are harder to drag on firm surfaces, but they are useful on rough ground and perform almost as well as runner-sledges on soft ground (Bulliet 2005:112, Dennis and Smith 1995:120; Figure 45). Direct dragging, of timber in particular, is also used today, and was employed in the Ancient Near East, from the Lebanon, Taurus and Amanus mountains to the Mediterranean and Euphrates for onward travel by water (Astour 1995:1402, Grigson 1995:268).



*Figure 45: Travois for hay-collecting in Södermanland, Sweden, early 20<sup>th</sup> century AD (Berg 1935:Plate VI.2)*

Aside from threshing functions, the archaeological detection of sledges and travois largely relies upon writing and depictions, unless evidence can be found of the characteristic erosion patterns of sledge and travois as mentioned above. Apart from the Uruk pictographs referred to above, early evidence of sledges includes a small number of late 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC texts, a seal, sealings and a stone plaque (APP II.25). The circumstances are clearly elite, and relate to a threshing function though apparently only in a ceremonial context. Also in an elite context is

the sledge in the 'royal' tomb at mid-3<sup>rd</sup> millennium BC Ur (Clutton-Brock 1992:68, Littauer [1983] 2002:10, Littauer and Crouwel 1990:18). In Europe, Pétrequin *et al.* (Pétrequin, Pétrequin, Arbogast &c) 2006:101 report that the earliest sledges have been detected in High Swabia in the 4<sup>th</sup> millennium BC, though Piggott (1980:25, 1983:35) cites sledge-runners in northern Scandinavia from the 7<sup>th</sup>/ 6<sup>th</sup> millennium BC. In Egypt, sledges are recorded from the 3<sup>rd</sup> millennium BC (Köpp 2013:111, Starkey 2000a:479)

### ***Stationary power***

Cattle and donkeys have also commonly been employed for providing stationary power, in Classical times, the recent past in the Western world, and developing regions today, as noted in accounts listed in APP II.29. This can take the form of wheel power (raising water, milling, pottery-throwing, spinning, butter-churning), hoisting (wells and irrigation, construction, loading of boats) and pressing (hay, cotton, clay, oilseed). The raising of water, from irrigation channels or wells, may have been a very early use of domesticated work-animals (Tann 1983:22), as it allows speedy shifting of much heavier units of water, as well as increasing the year-round utility of working animals (Barrett *et al.* 1982:8). Direct hoisting of weighty items was the original 'horse-power' (hp) used for engines, based on the weight that a horse could lift by pulling on a rope passing over a roller; use of stationary wheels reduces the direct power needed, so reducing the differential in ability between humans and working animals. Bulliet (1975:217) notes that when the wheel fell out of use in Egypt in the early 1<sup>st</sup> millennium AD, non-transport wheel use continued for stationary power such as lifting water, milling and pottery-making. In pre-conquest Mesoamerica wheels were also commonly used for non-transport functions such as calendars and toys (e.g. Kelekna 2009:354), and in Mesopotamia the pottery slow wheel was known from the Ubaid (Butterlin and Margueron 2006:318); it is therefore possible to conceive of the use of wheels for stationary power operated by working animals before their widespread use for transport.

Another non-transport use of donkeys today, described briefly in Chapter III.1, is their employment as guard animals for herds of cattle, sheep or goats. As donkeys have been associated since their first domestication with herders, it is possible to imagine their informal use in this capacity in antiquity.

***Implications for early use of working animals***

Before tracks and road networks there were constraints on use of wheeled vehicles for daily work, and early vehicles in Mesopotamia may have been largely for ceremonial use. As discussed in Chapter VII.1, the use of donkeys for pack is often preferred to this day in developing regions, but the commissioners of texts and representations did not concern themselves with such activities and they are absent from the official record.

New evidence indicates that sledges were used for threshing from an early date, in the fields as well as for the ceremonies depicted on sealings, and it can be envisaged that tying a basic tree-branch construction to working animals for transport of bulky or heavy goods may have emerged independently in many instances, as also with early enlisting of animal power to haul water from wells or irrigation channels.

### VII.3 Long-distance pack-donkey caravans

#### *The invisible long-distance pack donkey today*

In contrast with other parts of this thesis, where plentiful modern material informs interpretation of the fragmentary findings in antiquity, this chapter does not provide detailed analysis of its subject. The reason – the invisibility of pack-donkey caravans in antiquity and to the present day – is a finding in itself. There has been strong interest throughout history in conducting profitable activities under the radar of authorities, and the advent of the donkey for long-distance transport may have provided that facility from earliest times of its use. Modern caravan-drivers worldwide seek invisibility not only from tax-hungry authorities and preying bandits, but also from the unwanted attentions of NGOs who would regulate and publicise their treatment of working animals. Further barriers to information on pack-caravans are encountered in Latin America where recording of working-animal activity is often funnelled through veterinary services (Chapter I.2), who are unlikely to be visited by caravaneers. Few researchers from any discipline have the time and resources to follow modern caravans, with valuable exceptions found in Helina Woldekiros (pers. comm. 2016) who accompanied donkey and camel caravans in NE Ethiopia as part of research for her PhD (in progress), and Nielsen (2001) who accompanied a llama-caravan in Bolivia, reporting in detail on the caravaneers' motivations, activities, routines and the archaeological implications.

Smuggling could be considered as equivalent to trade before the capability of authorities to impose taxes, and equivalent in aim to diversion of routes to avoid unregulated raiding. Laden donkeys can negotiate rocky, precipitous paths (more so than the later camels), and advantage was taken of this by Assyrian merchants in the early 2<sup>nd</sup> millennium BC for taking difficult back-routes into Kaneš to avoid tax-payment on their goods (Larsen 2015:157-8/173/179, Veenhof 1972:34/323-38). Modern entrepreneurs in Africa and elsewhere, including from Turkey into Iran and Iraq, and between Lebanon and Syria, have taken this a step further, making profitable use of donkeys' excellent memory for routes, good night vision and ability to work unsupervised by sending large trains of donkeys (and mules) unaccompanied across national borders laden with smuggled goods, through desert, mountains or dense vegetation where capture is unlikely; APP II.2 lists references to a range of accounts from Africa and the Near East of this busy industry.



Most descriptions of donkey-caravans are therefore garnered from accounts of travellers in recent centuries, as with the examples below, and are highly anecdotal; considerable original research would be required for an authoritative account. Riemer and Förster (2013:36-52), as part of their valuable work on modern caravans *Desert Road Archaeology in Ancient Egypt and Beyond* (Förster and Riemer (eds.) 2013), list some of the few studies extant on northern African and Latin American donkey-caravans, many focusing largely on geographical information; some caravans also continue in mountainous areas of China and Nepal (Förster *et al.* 2013:208). The Riemer and Förster team themselves in their local investigations in northern Africa only encountered one modern pack-donkey caravan, by accident (Förster *et al.* 2013:211), for informal interview. They underline the many variables in any statistical analysis of time and load (Förster *et al.* 2013:212): condition of the donkeys, terrain, climate, duration, daily travel routine, experience of the animals and drivers, and particularly the available feed and water along the route, which dictates the hours travelled. A key point to note is the fundamental difference between the practices for pack-donkey caravans and those consisting of donkeys being transferred long-distance for sale (see Chapter IV.1); there is a strong incentive to maintain the for-sale donkeys in good condition, though travel can be more rapid as there is relatively little daily unloading and loading (Förster *et al.* 2013:193-212).

Nielsen (2001), referring to Bolivian llama-caravans, also describes the many factors in journey decisions and scheduling. Income factors include non-caravan work availability, demand (and so price achieved) for goods at various selling-points, competition, opportunities for *en-route* trading, while practical factors include route knowledge, availability of firewood, danger from predators, grazing and fodder availability on the road, condition of animals, and weather conditions; information on all these is gathered from other caravaneers (p166). Caravaneers may have regular trading partners at destinations, though some caravaneers may prefer flexibility to reliability and may even divert at times to avoid having to deal with their partners at perhaps a lower price (p166/183). The number of animals in a caravan must be sufficient to provide enough return on the journey per caravaneer but not too many for the team to handle (p168).

An account by Cable and French (1950:159-60) vividly encapsulates the nature of medium-distance donkey pack caravans in western China in the 1920s/ 30s AD. 'One man, or at the most two, will drive twenty donkeys, riding behind them,

shouting incessantly, and never letting them slacken to normal walking pace' (Cable and French 1950:159). At inns, the driver removed their panniers, put fodder in the mangers, and slept briefly before driving them on again.

The donkeys are small and cheap, so he is careless of life and sacrifices them in large numbers to his passion for speed and his reckless output of strength. He will use dangerous short-cuts over which no other class of transport-man will venture, and in bad weather many beasts die by the roadside. (Cable and French 1950:160)

Five stages were completed in three days, with the business-owner awaiting the caravan at the end; the donkeys and driver rested for 24 hours before embarking on the return journey.

For longer-distance journeys, the few accounts of donkey-caravan operation in Africa offer glimpses of the complexity and organisation involved. The long-established salt caravans in north-eastern Ethiopia (Figure 46), dating from the 6<sup>th</sup> century AD and described in Chapter IV.1, fed important salt-bar exchange currency into markets, for purchase of goods and livestock also brought long-distance; references to accounts of this system are listed in APP II.22.



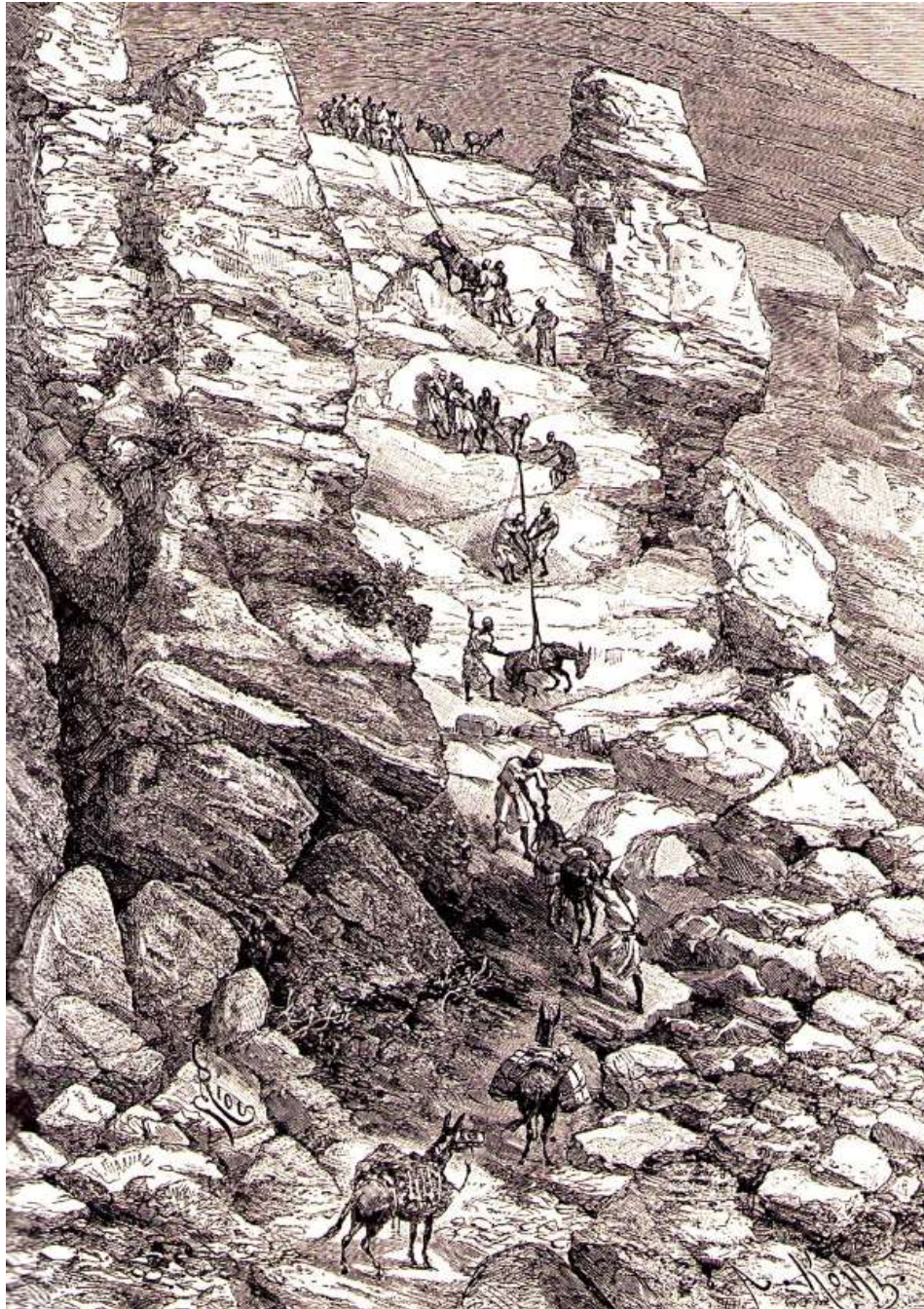
*Figure 46: Salt caravan from the Danakil Depression, Ethiopia*  
(<http://theonearmedcrab.com/hamed-ela-and-lake-asale>, open access [accessed 23 June 2017])

Vast caravans were assembled, by small traders allying themselves with the large merchants (Pankhurst 1968:347): '[w]hile the going was good the merchants tended to divide up to avoid too much concentration in one area, while in periods of

insecurity they stuck together to defend themselves' (Pankhurst 1968:352), and '[h]alt[ing] places were often in isolated areas to avoid disputes with local populations' (Pankhurst 1968:347). There were no caravanserais, but temporary stone walls were built for protection and storing of packs; animals were led away from the camp to graze, then tied to stakes, and sometimes protected from predators by a thorn fence. As with the Chinese donkey-drivers above, 'the merchants always overloaded their animals, and if they dropped from fatigue their masters would throw away their burden.' Donkeys were commonly used; choices also included camels, mules and humans (including women), depending on cost/ weight/ speed calculations (Abir 1966:3, Pankhurst 1968:283).

In a similarly complex arrangement, since several hundred years ago and continuing today, a figure-of-eight donkey-caravan route has operated whereby the Yarse of central West Africa convey cotton goods and cereals northwards to Saharan markets such as Timbuktu and return with salt slabs; some of these are then taken by different (and fewer) caravans to southern West Africa; there in Ghana the donkeys are in high demand among Hausa traders, who use them to carry kola nuts (highly valued for chewing) back to the Saharan region (Binger 1892, Förster *et al.* 2013:210-12, Izard 1971). Dried fish, matting, sheep/ goats and agricultural products are also carried. The caravans consist of the merchants and their escorts and pack animals, mainly donkeys/ mules (see Figure 47) but also oxen for the journeys to the north. If the route is dangerous, an armed guard is added for every 1.5-2 animals; the total caravan consists of a minimum of half a dozen animals and sometimes more than 600. Förster *et al.* (2013:201/210-12) describe how Rudolph Kuper accidentally met a Koro-Timbuktu caravan, moving north with millet, and interviewed the caravaneers, recording how they were able to load donkeys heavily on this leg of the route as grazing and water were available for the consequently slow-moving caravans. Donkey-caravans travel all day except for a period from noon; in summer, when there is more need to reach the next water-stop, they may also travel late at night. During breaks the donkeys are supervised but not tied, except at night and during sandstorms.





*Figure 47: Pack animals being hauled up a precipice in Africa (Binger 1892:363)*

While detailed parallels with camel-caravans can certainly not be drawn, an account of late 16<sup>th</sup>-century AD camel caravans in Syria and Mesopotamia (summarised by Grant 1937:134-9) affords examples of necessary preparations for a desert journey. Security on the route was arranged with guards and through 'protection' payment to local nomadic groups; if an attack was feared, the packs were stacked to form a defence. Camel-drivers were very low-grade, in contrast with caravan-guides (often local) and leaders. Later accounts describe how caravans were commonly large

joint enterprises, for security and pooling of costs (Grant 1937:127); tolls were a major burden, imposed by locals and authorities at pinch-points such as fords (Grant 1937:153/166). Meerpohl (2013:180-90) describes issues with raids and local conflicts for modern Saharan camel-caravans, and the importance of a local guide and of arrangements for meeting suppliers of water and fodder.

The breeding of donkeys for caravans overlaps with that of breeding for other uses so is briefly discussed in Chapter IV.1. Donkeys are confirmed by a range of regional commentators in sub-Saharan Africa to be readily trainable for pack (APP II.2), especially if regularly employed, with foals accompanying their mothers on caravans given small packs to accustom them.

### ***Early long-distance transportation***

Note on the term 'trade': There is rich discussion on the definition of 'trade' as distinct from exchange, barter and other systems (some commentators are listed in APP II.22). Milevski (2011:7-9) prefers the Marxian term 'exchange' for transactions in periods without some form of standard equivalent, but notes that 'trade' has an etymology relating to travel. Sherratt (1997a:5) takes a robust view: '[t]he common usage of 'trade' and 'exchange', where the former is taken to imply a profit motive and the latter a socially embedded network of gifts, can easily lead to a prehistory in which there are no gainers from material transactions.' Crawford (2013:448) defines 'trade' in a Mesopotamian context as 'the commercial exchange of goods which takes place on a regular basis and where each party sees themselves as satisfied with the outcome', and for brevity and practicality I use the term 'trade' here for all such activities.

Early long-distance conveyors of goods may have been groups and individuals walking from place to place for other purposes, such as hunting or herding. In the 6<sup>th</sup>-4<sup>th</sup> millennia BC regional livestock markets, as still operating today (Chapter IV.1), could have become points of goods-exchange for seasonally-mobile pastoralists (see Chapter VIII.4 on mobile pastoralism). Hole (1978:140-60) suggests from modern Zagros examples that nomads in the 4<sup>th</sup> millennium BC would not necessarily have required pack animals for long-distance movements; he agrees that the adoption of pack donkeys allows for more baggage and longer journeys, but considers that humans could otherwise carry all goods for exchange



as well as necessities. In contrast, Moorey (1994:12) maintains that although the exchange system was established before the use of pack animals, '[t]he history of the Near Eastern deserts began with the beasts of burden which enabled man to lead a nomadic life', citing examples in mediaeval and early modern times where 'the ability of nomadic peoples to pass through inhospitable regions' was central to supply of material from remote regions. Algaze (2008:68) notes the lack of evidence for systematic long-distance human portage in the 4<sup>th</sup> millennium BC Near East; with Zarins (2014:188) he suggests that it was the advent of donkeys that facilitated the intensification of trade (APP II.22) apparent in early texts, as in the 3<sup>rd</sup>-millennium BC account mentioned in Chapter II.2 of grain carried by donkey to Aratta (though Liverani (2006:44) considers that this was an ideological myth and that grain was not carried long-distance). There is still little direct archaeological evidence of the traded goods themselves (Algaze 2001a:207, Algaze 2008:65/156, Lamberg-Karlovsky 1996:86), as many were perishable, or of their means of transport (Zarins 2014:199), but a marked proliferation of outposts and waystations at land-water and highland-lowland intersections (commentators on this are listed in APP II.22) and an increase in zooarchaeological evidence of domesticated donkeys, as noted in Chapter II.1 on their early adoption for work.



*Figure 48: Tuareg child in Niger moving camp with donkey and dwelling-frames (© Galen Frysinger 2001, open access)*

Modern and historical African examples of mobile pastoralist cultures indicate that the pack donkey has consistently been a major enabler of greater flexibility of movement, allowing groups to move further between camps (Figures 9 and 48), live further from water sources and exploit more marginal areas; APP II.20 lists commentators on this usage in a range of African regions. Sherratt's (1981:287) donkey-less model of 'the added mobility given by draught and riding-animals' for 4<sup>th</sup>-millennium BC pastoralists was influenced by accounts of horse-riding and ox-carts in the northern steppes (see Chapter II.1) and is now considered unlikely. In a possible parallel alongside the subsistence-surplus models of the development of farming (see Chapters II.1 and V.5), there may be a case for envisaging the role of the donkey in the development of new forms of livelihood for mobile or semi-mobile groups. As outlined in Chapter II.2, early introductions of domesticated donkeys may have resulted from interaction between mobile and sedentary groups; these interactions are likely to have generated exchange not only of domesticated animals but of goods and products, which on the mobile pastoralism side may have included long-distance transported goods, items from desert regions, and dairy and other secondary products. Levy (1983:15) refers to a system operating in the southern Levant from the Early Bronze Age of 'the intensive and well-structured exploitation of the secondary products (milk, wool and hair) of domestic herd animals such as sheep and goat'. This development in itself – archaeologically-detectable in some instances (e.g. Evershed *et al.* (2008) on detection of use of dairy products) and reported ethnographically (e.g. Halstead 2005) – would have been likely to require greater pack abilities than pure 'subsistence' pastoralism (Louise Martin pers. comm. 2106). In a further development, as expanded on below, mobile groups may have become specialists in transportation of materials and goods. Renfrew *et al.* (1966:52) suggest for example that the development of metallurgy east of the Zagros mountains in the 5<sup>th</sup> millennium BC, with the need to transport heavy materials long-distance in quantity, generated a new need for full-time specialist traders free of fixed pastoral itineraries, and perhaps a motivation for enlisting donkeys for pack (Matthews and Fazeli 2004:70, Potts 2011:169-72).

Separately, space is lacking for discussion of comparison factors for Mesopotamian boat and pack-donkey transport. As with sea, road, rail and air freight today, river- and canal-boat and pack-donkey transport systems were complementary, with the latter providing 'feeder' local and tributary systems (see Chapter VII.1) for the increased water traffic. Commentators on Mesopotamia may be influenced in their focus on boats by the example of Egypt, where land transportation was very much

subordinate to river transport and used mainly for local carrying (Bagnall 1985:5); but Egypt has only one river and mainly lacked the major tangential land trade links long-established in Mesopotamia. Another likely influence is the well-known 2<sup>nd</sup>-millennium BC Hammurabi text cited earlier, referring to the importance of boat transport in the south.

Boats had the indisputable advantage of volume (APP II.38), making them cost-efficient even when towed (Algaze 2008:53/61-2). As well as the larger boats, a system of small rafts on the Mesopotamian rivers has been reported from the 1<sup>st</sup> millennium BC to the 20<sup>th</sup> century AD, in which quffahs (circular rafts made of rawhide stretched over a basketry frame) and keleks (rafts buoyed up by inflated goatskins) travel downstream with cargo and a live donkey; on arrival, the raft/frame materials are sold and the skins transported back upstream by the donkey (APP II.38). However, letters from the 2<sup>nd</sup>-millennium BC Archives Royales de Mari (e.g. ARMT XIV.4) and the Code of Hammurabi refer to shipwrecks on both the Euphrates and the Tigris, and to seasonal low waters. As 20<sup>th</sup>-century AD surveys of the region recount, the Tigris is steep, with narrow, tortuous sections and shifting sandbanks; occasionally the prevailing north-westerly wind reverses so that boats have to be towed downstream as well as up (APP II.38). Evidence of taxation and raids affecting transport choice emerges from several of the Mari letters (raids: ARMT I.83, I.100, II.123, V.23, XIV.86; taxes: ARMT XIII:58-101 (Cooper 1992:4-7); and see APP II.22); they indicate that donkey caravans were more able to detour to avoid taxation/ customs duty posts and hostile regions but were more subject to attack (see also the paragraphs on Kaneš below), though raids were also made on boats (APP II.38). David Oates notes that

the Great Desert route of the eighteenth and nineteenth centuries [AD] consistently kept a day's or even two days' march west of the river [Euphrates], since the regular toll exacted by Beduin was a lesser burden than wanton plundering by the villages of the riverain land, who enjoyed a particularly evil reputation. (Oates 1968:6)

Milevski (2011:195) points out, though, that the common mention of robbery of donkey caravans in the Mari texts may have more to do with 'ethnic abhorrence against nomads, mountainous population, etc' than with a genuine crime-wave.



### ***The invisible donkey***

Until recent years there has been very little scholarly focus on the logistics of early donkey transport. Key commentators on Mesopotamia (APP II.22) until recently made only passing reference to the donkey, and there is only very rarely speculation or interpretation on how the new donkey trains were organised and equipped, or on how and where the animals were bred, kept and disposed of. In Mesopotamian commentary the donkey is often sidelined by the traditional focus on boat transport on the Tigris and Euphrates (see above), while in the 3<sup>rd</sup>-millennium BC southern Levant the subject has often fallen between the stools of zooarchaeology and discussion of trade/ exchange. There are some accounts of caravan waystations (Oates 2003:115-20 in Mesopotamia, Oren 1989 in the southern Levant) and references to donkey- and hybrid-breeding at 3<sup>rd</sup>-millennium BC Nagar (Oates 2001:279, 2003:117); otherwise, there is little evidence of the archaeological data being approached with the aim of detecting the daily practicalities of donkey usage. Wilkinson (2016) argues that

[f]or the most part, the study of large-scale trade and exchange in the ancient world remains distanced from the physical hardships of real human travel. Ancient trade or, more neutrally, ancient 'interaction' is often discussed as if it took place between actors who inhabited a flat and unchanging spatial surface. (§1)  
Physical landscapes are quietly ignored in the face of social models (e.g. world-systems, peer-polity etc. are essentially social-structural models and ignore or avoid geographic determinism). (§15)

There are growing signs, though, that archaeological interest is turning towards early long-distance pack donkey transport. Algaze, in his important 2001a *Current Anthropology* piece, attributed the explosion of trade and urbanisation in the 4<sup>th</sup> millennium BC in southern Mesopotamia to 'social and "technological" innovations' (Algaze 2001a:200) but referred only to water transport, dismissing donkey transport as 'less efficient' (p204) rather than as fulfilling a different and crucially complementary role. By 2008, though, the domestication of donkeys features in his book as a key facet of the technological basis of the advance of southern Mesopotamia (Algaze 2008:66), with donkey caravans suggested as 'the principal method of overland carriage for long-distance trade in the area following the domestication of the donkey in the 4<sup>th</sup> millennium BC' (Algaze 2008:55). This role and its impact are more recently underlined by Zarins throughout his 2014 work *The domestication of Equidae in third-millennium BCE Mesopotamia*, though his

assertions suffer from his desire to ascribe similar causation and impact to the domestication of the horse in the northern steppes and the donkey in the Near East, 'at the same juncture as the rise of "civilization", ca. 3000 BCE' (p249).

Similarly for the southern Levant Ben-Tor in 1986 discusses trade, urbanisation and the factors in the accumulation of agricultural and other product surpluses with no mention of donkeys, but by 1992 adds the donkey and ox to his list of key factors (Ben-Tor 1992:84). Commentary on the means of land transport grew further with Levy's focus on the donkey in the Negev/Faynan copper trade (e.g. Levy 1995:234) – and his experimental journey with an ore-laden donkey (Golden 2002:232). Barker and Mattingly (2007), too, have conducted an ethnographic study of mobile pastoralists (suggested by commentators (APP II.36) as likely donkey-caravan operators in the region in the Early Bronze Age) in the region of the Faynan copper-mines. Copper ore was mined here from the 5<sup>th</sup> millennium BC, with some perhaps worked onsite even at this early stage; the ore and copper goods were conveyed to the Beersheva valley for working or onward supply (see APP II.22 for references), and this transportation process intensified throughout the 4<sup>th</sup> millennium BC and beyond. Possible donkey-corral have been found at Faynan, and domestic donkey bones and evidence of donkey-keeping at Shiqmim in the Beersheva valley (Barker and Mattingly 2007:104). In addition to the huge quantities of charcoal (or wood for its production) required for the smelting, Mattingly *et al.* (2007:345) calculate that supplying food to the Faynan workers would require 2,800 donkey-journeys per annum, plus water, pottery and personal goods. As in the region today, local pastoralists may well have been involved in the transport and trade processes (Joffe 1991:18), protecting their own pasturing lands by ensuring that the transport authorities also supplied fodder for the donkeys (see Chapter VI.1). Increasing use of donkeys might also be visible in greater dispersal of facilities, such as the installation of formal burying grounds well outside settlements to which the dead could now be conveyed long-distance (see in Chapter VII.1). Camel caravans were later added as complementary to the donkey system, able to traverse the Arabah and Negev deserts but not to climb the steep sides of the plateau (Mattingly *et al.* 2007:345). Mules and donkeys are used for transport in this region to this day, as wheels are impractical (Palmer *et al.* (Palmer, Gilbertson &c) 2007:50).

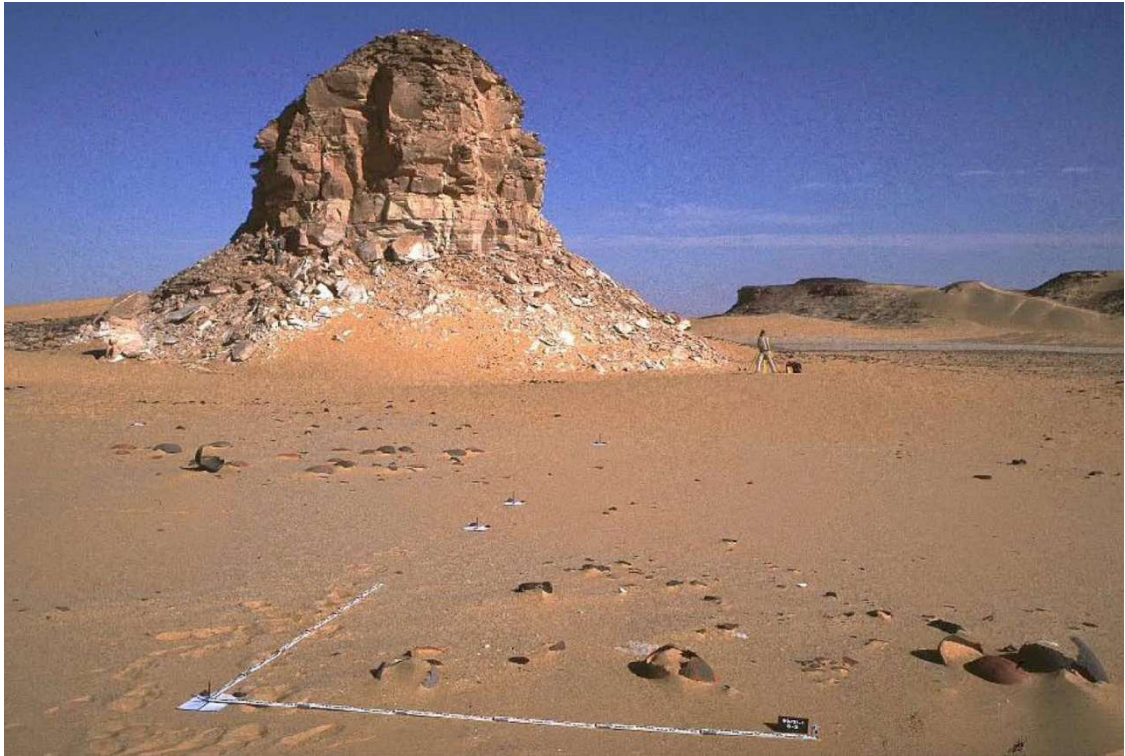
In the Negev, although there is evidence of Egyptian involvement with the copper industry there, commentators consider that they may have obtained their own copper from more local sites rather than transporting it long-distance from the

Negev (Golden 2002:227-32, Ilan 2002 317). However, there was already considerable down-the-line long-distance transportation in the 5<sup>th</sup> millennium BC between Egypt and Canaan, of heavy items such as flint, stone and shell. Prior to the systematic use of donkey-caravans these were perhaps carried by nomadic groups, although the initiators may have been Egyptian or local elites (see APP II.22 for references). As indicated by Sherratt's (1981:288) diagram (Figure 8 in Chapter II.1), 4<sup>th</sup>-millennium BC long-distance caravans then developed from Canaan to Egypt (APP II.36), carrying olive oil, wine, and also asphalt and possibly salt. Heavier items may already also have gone by sea, but these still required feeder transport from farming and desert areas (Marfoe 1987:26, and see on 'railheads' in Chapter VII.1). Milevski (2011) and Greenfield *et al.* (2012) also highlight the working donkey more generally in the southern Levant with examination of zooarchaeological remains and burial practices (see Chapter II.2). Recent isotope analysis of a donkey skeleton from Tell es-Safi in Israel indicates that that the animal might have been reared in the Nile valley and spent only a short time in the Tell es-Safi region before its (possibly sacrificial) death (Arnold *et al.* 2016), offering potential new direct demonstration of the movement of donkeys between Egypt and Canaan in the early 3<sup>rd</sup> millennium BC.

Within Egypt, donkeys became invaluable transport animals from the 3<sup>rd</sup> millennium BC, as illustrated by Köpp:

[t]extual evidence shows that donkeys were used as a means of transportation on travels and expeditions, e.g. in the Old Kingdom on the journeys of Harkhuf, who took 300 donkeys with him ... and Sabni, accompanied by 100 donkeys .... A stela dating to the Middle Kingdom from Toshka-West mentions 1,000 donkeys accompanying a mission ... Further missions to Sinai during the Middle Kingdom record the number of donkeys as being 200, 500, and 600. (Köpp 2013:110)

A recent illuminating discovery in Egypt can also usefully be mentioned here; a chain of staging-posts has been found for a desert donkey-caravan route dating back to the late 3<sup>rd</sup> millennium BC and now known as the Abu Ballas trail (APP II.22; Figure 49), with evidence of a sophisticated system of providing 'sign-posts' *en route* and food and water at staging-posts (Förster 2013:297-5).



*Figure 49: Abu Ballas trail distinctive rock-mound and storage jars (Förster 2007a, Fig. 13. © Rudolph Kuper; by permission)*

### ***The Kaneš texts***

An account of the long-distance pack donkey in the Ancient Near East would not be complete without mention of a unique later body of material, the large cache of early 2<sup>nd</sup>-millennium BC clay tablets discovered at Kültepe (ancient Kaneš) in Anatolia, detailing the large-scale donkey-caravan trade in tin and textiles between here and Aššur (Figure 50), 1000 caravan-kilometres to the south-east and a journey of six weeks (Larsen 2015:176). These describe a well-orchestrated system of transporting high-value goods using well-established transport technology (APP II.22): the texts indicate that this trade system was already established by c.2300 BC (Brodie 2008:299), though caution must be employed in extrapolating models from this back a millennium to when significant use of donkey caravans can first be deduced.

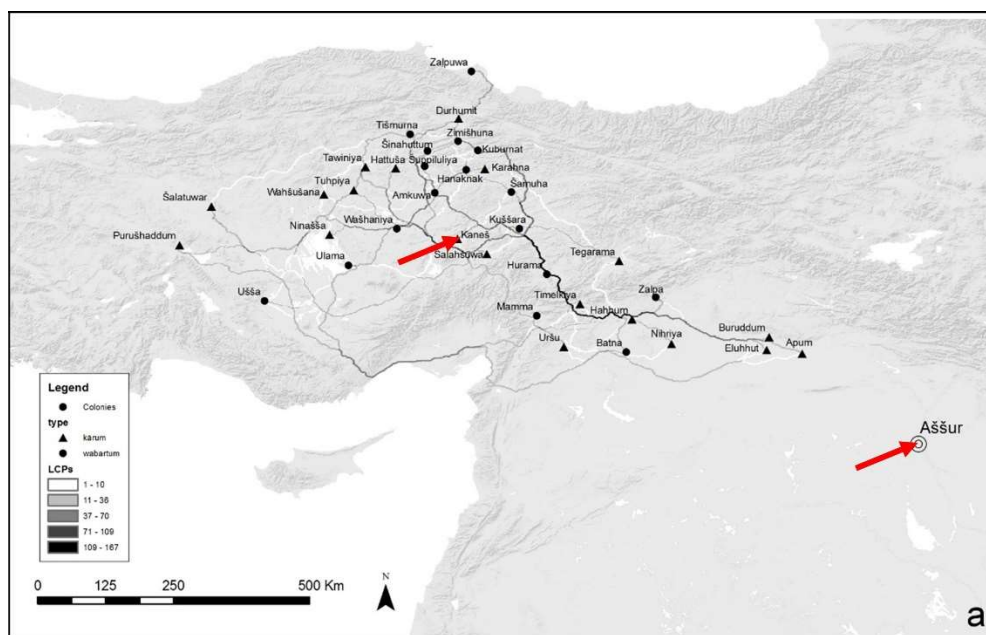


Figure 50: Early 2<sup>nd</sup>-millennium BC long-distance routes between Kaneš (central Anatolia) and Aššur (northern Mesopotamia). Cumulative least cost paths (LCP) for each pair of Old Assyrian commercial settlements for Kültepe's lower town, level II period (c. 1970-1835 BC). Darker values (black) indicate cells with the highest number of overlapping paths (Palmisano 2017:39 Figure 5a, by permission)

There are references in the Kaneš texts to donkeys being bought and rented *en route* and sold at the end of their journey, as the burdens on the return journey (particularly silver) were considerably less bulky; but many of such practical details of the 'donkey process' did not form part of the text-writers' concerns. Barjamovic (2011:34) speculates on the unmentioned major agricultural and logistical systems that must have arisen at waystations/ inns *en route* supplying water, fodder and food for up to 300 donkeys and their drivers (see APP II.22 for references to commentary on the size of caravans). Michaud and Michaud ([1977] 1978:§2 p4) record how in modern Afghanistan innkeepers make a good income from selling fodder to caravans, guarding the animals and selling the dung for fuel.

There are some indications that Assyrian caravans included as many human escorts as donkeys; modern examples demonstrate that a single driver can control dozens of donkeys in a caravan, and as noted earlier in this chapter wholly unaccompanied donkey-trains are used for smuggling today worldwide; but the donkey-to-human ratio is affected on long journeys by the need for timely unloading and reloading at stops – a factor noted as applying up to recent times with mule and reindeer pack-trains (e.g. Dent 1972:159 (US Army mule-trains), Hassig 1985:193 (mule-trains in colonial Mexico), Ingold 1980:171 (reindeer pack-trains in Lapland)).

It appears from the Kaneš tablets that the loading issue was dealt with on the 2<sup>nd</sup>-millennium BC Assyrian caravans by assigning one driver/ packer (*sāridum*) to every one or two donkeys; this partly came about because the Kaneš caravans generally consisted of a convoy of several merchants, for support, company and security, each with his own small consignment carried on up to half a dozen donkeys, with the merchant's own drivers/ packers (APP II.22). Foot travellers may have also made use of the caravan to travel in safety; the accounts in the 2<sup>nd</sup>-millennium BC Archives Royales de Mari to raids and organised banditry are referred to earlier. The Kaneš caravans seem less prone to attack, perhaps through prompt reprisals or agreements with local rulers (Larsen 2015:156/176). Barjamovic (2011:35) notes that large caravans are only known in the later period of the Kaneš trade, perhaps because the political situation in the Syria region had worsened by this time – a precaution taken on pack-caravans to the present day, as noted earlier.

### ***Long-distance human portorage***

#### Evidence of porters in antiquity

Human porters rarely appear in representations or texts in the Ancient Near East, perhaps reflecting (as with donkeys) their lowly function. It may be that much long-distance movement of materials was conducted point to point by individual mobile pastoralists and hunters, rather than by organised portorage; slaves or captives exchanged between Mesopotamian regions (Leemans 1968:214) may also have been given packs. By the 3<sup>rd</sup> millennium BC laden porters, alongside led equids, are shown on the Standard of Ur (Figure 53), and Boese (1971:168) notes representations at Tell Agrab, Khafaje and Nippur of head-loads and of a storage jar carried on a pole between two porters. As noted in Chapter II.1, captives used for labour were categorised by age and sex in the late 4<sup>th</sup>-millennium BC Uruk Archaic Texts using the same terms as for state-owned cattle, suggesting a perceived equivalence of human and animal labour; similar attitudes are apparent in early Indian texts (Tani 1996:403-5) and in Rome (Tapper 1988:59). 3<sup>rd</sup>-millennium BC texts from Lagash record that sons of captive females were castrated and set to towing boats (Tani 1996:405), and daughters set to weaving, though there are accounts of females also towing boats (see Chapter VIII.3); human towing continues in the Near East today (de Graeve 1981:151-2).

Use of captives or encumbered labourers for long-distance pack carries disadvantages: they may abscond (with the goods), and will probably carry less and move more slowly than well-fed self-employed professional porters. Local porters – probably in the latter category – are mentioned in the 2<sup>nd</sup>-millennium BC Kaneš texts as being recruited within Anatolia to carry goods between towns when the pack donkeys from Aššur have been sold off (perhaps to the buyers of their loads). The Kaneš porters were given food and payment; there are examples of porters refusing to travel on routes with brigands or icy roads and having to be substituted by donkeys (Dercksen 1996:61-3, Michel 2004:191). Human porters are 'expensive' if they are taken away from agricultural or other production (Brodie 2008:301), but can more easily be sent away to find other employment in downtime. A separate category of travelling human in Mesopotamia comprises messengers, recorded in a few late 3<sup>rd</sup>-millennium BC texts, who travelled on foot and by boat, shifting to horseback in the 2<sup>nd</sup> millennium BC or later (Moorey 1970:48).



*Figure 51: Kulbar porters in Iranian Kurdistan (© Kurdistan24, by permission)*

The Kaneš porters may bear some comparison with the Sherpas in modern Nepal, who are self-organised, with a system of *sirdars* (experienced foremen) to arrange groups for expeditions or large construction projects (Fürer-Haimendorf 1984:65-7, Malville 2001:234). These similarly operate a complementary system to donkey and mule caravans, with porters prevailing in the more remote areas and where the Himalayan rope bridges across ravines prevent use of animals. In Kurdistan both mule-caravans and *kulbar* porter groups cross the borders between Turkey, Iran



and Iraq (as with the unaccompanied equids carrying smuggled goods noted above), with villagers unable to afford a mule carrying massive loads themselves (Figure 51).

The *tlamemes* (various spellings) of Aztec-period Mesoamerica were also professional porters, responsible for much of the raw materials and goods transfer long-distance (Figure 54). With the advent of competition from mule transport brought in by the Spanish, human portage resolved itself into a minor, complementary system (Hassig 1986:137). In its heyday, though, *tlamemes* were hired by Aztec merchants and normally operated on a relay system, resulting in the establishment of a chain of settlements a day's walk apart (Hassig 1985, 1986). Relay systems of portage allowed heavier loads, longer daily distances and fewer rest periods, and flexibility of personnel if for example bulky raw materials were carried in one direction and smaller finished goods in the other. Local porters for each stage would also be more accustomed to the altitude, climate and terrain: Aztec merchants would use the same team for the whole trip only where replacements would be unavailable *en route* or local authorities were hostile (Hassig 1985:122-5). While relay systems for ridden equids, such as the post-horse system, are not uncommon in more recent times, it appears that long-distance donkey caravans, in antiquity and now, use the same animals for the whole journey. This may reflect the problems in maintaining large stocks of idle animals at each changeover point, whereas porters can find other employment and maintain themselves.

While the *tlamemes* were apparently male and the Sherpa porters are both male and female, portering in many parts of the world is traditionally female: in Africa, among Native Americans in pre-horse days, and among the nomads in Iran and Kurdistan. Early groups transporting items long-distance may well have included women, but evidence is slim (see Chapter VIII.3). Chapter VII.1 gives a detailed discussion of the widespread practice of short-distance female burden-carrying and the transformation of their daily lives with the adoption of donkeys for this work. Engels ([1884] 2004:65) bases part of his overall argument on the situation of women on 'barbarian' native Americans using captive women purely as wives and mothers, but Ewers (1955:308-315) and Hämäläinen (2008) indicate that they were also captured for manual labour including perhaps portage. Ewers (1955:308-315) describes how, with the advent of the horse among Native Americans, women – the chief load-carriers – enjoyed higher social status and were freed to engage in other



profitable tasks such as crafts; their status in the group improved, while the focus of raiding of other groups shifted from women captives to horses.

#### Comparison of human and donkey pack capacity

There is very little consensus on the load weights that can be carried by humans (see example figures in APP II.28); African and other figures cluster round 30-40kg – so about half what a donkey can carry long-distance – but common anecdotes of Sherpas in Nepal (who are small but well-muscled, with special walking and resting techniques) regularly carry well over 100kg up the Himalayan foothills. Calculations are complicated by algorithms of weight vs. distance vs. hours per day, the frequency of rest periods, and whether food or fodder has to be carried; but typically humans and donkeys walk at a similar speed. Loads, calculated as a percentage of body mass, are less for women who typically have less muscle per body mass.

Table 6 below gives approximate median figures from sources that are often anecdotal and heavily influenced by many factors as discussed below; information on the effect of hours per day is minimal.

Table 6: Human/ donkey capability comparisons

(See APP II.28)	Human	Donkey (i)
Load (kg)	Typically 25-40kg (ii)	Typically 50-80kg, or 100-150kg or more for shorter distances (Figure 52)
Speed (km/ hours)	4-5km/h	4-5km/h
Distance per day (km)	15-20km	Typically 25-30km, or up to 40km

(i) *Accounts in the early 2<sup>nd</sup>-millennium BC Kaneš texts suggest 50-80kg loads for donkeys (Brodie 2008:301) and 30km distance per day (Brodie 2008:301, Bökönyi 1980)*

(ii) *Excluding the very large loads carried by Nepali porters (APP II.28)*

Humans can team up to carry awkward objects (though donkeys can also be lined up to carry long objects); bulk (textile, fodder) is more of an issue than weight. Humans can load themselves, and lift loads over obstacles, and can potentially be sent to arrange their own food and obtain employment in gap periods. Donkeys are more energetically efficient than humans in most terrains, but humans can traverse steeper and more difficult terrain than even donkeys (Binger 1892:318, Clark and Haswell 1970:204, Hassig 1986:145); see Figure 47. The efficiency of both is affected by size, fitness, level of nourishment, experience, muscle development

related to the loading method, and whether accustomed to the climate and altitude (Bastien *et al.* 2005, Binger 1892:490, Sasson 2010:27). A key factor in the advantage of donkey pack over human is their physiological greater efficiency in transporting weight: donkeys make different and more economical use of muscles and other bodily elements for bearing loads, as outlined in Chapter III.1. Yousef and Dill (1969) and Yousef *et al.* (1972) suggest that these adaptations may account for donkeys' high energy output to food intake; beyond about 20% of liveweight, human energy costs for carrying rise steeply, unlike those of donkeys. The fuel cost of using donkeys, overall and per load, is thus considerably less than that for using humans; the gap is widened by donkeys' greater tolerance of heat than humans (Schmidt-Nielsen 1964:88-92), the greater absolute load and ability to carry large-volume goods such as textiles and fodder, and the reduction of need for regular water supply and provision of food.



*Figure 52: Laden donkey, Ethiopia (© The Brooke 2012, by permission)*

Another factor in choice of humans or animals for pack can be the effectiveness, in terms of design and quality, of pack equipment, which may limit the size, shape and weight of items carried by humans or by animals. The porters shown on the 3<sup>rd</sup>-millennium BC Standard of Ur (Figure 53) seem to use a wooden packboard, as do Nepali porters today; humans also carry items on their heads, on their backs with a headstrap or as a backpack, or on poles or yokes (Dennis and Smith 1995:12-13,

Dixit 1995:35). Finally, choices are and presumably were made on the basis of availability of humans or animals, including competitive bargaining on the part of porters and donkey caravaneers, and for animals on their value at the destination. In Saharan Africa donkeys are chosen for conveying salt slabs where the destination region is unsuited to camels or where there is more of a market for selling donkeys (Gebreab 1998:16, Izard 1971:221). Historical or cultural factors also have a role, as in Nepal where '[i]n the eastern hills, human porters carry most of the goods from the road-heads into the more remote areas, whilst in the western hills this task is carried out largely by teams of donkeys owned by transporters' (Lawrence and Pearson 2002:107).



*Figure 53: Detail from 3<sup>rd</sup>-millennium BC Standard of Ur Peace Panel, British Museum (Jill Goulder 2014)*



*Figure 54: Aztec professional porters; detail from 16th-century AD Florentine Codex (Wikipedia <https://en.wikipedia.org/wiki/Pochteca> [open access; accessed 30 June 2017])*

### ***Detection of changes in long-distance transportation modes***

The invisibility of laden animals travelling across remote territory leads to evidence of the operation of donkey-caravans in antiquity in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia being largely derived from texts, with their inevitable constraints. Postgate (2003:8) comments famously that '[i]t has often been said that the Aššur-

Kaneš trade is not something we could have reconstructed.' Working-animal evidence such as bone pathologies are discussed elsewhere in this document; with the new work done by Shackelford *et al.* (2013) on the slower, steadier gait of working equids compared with wild ones, it may come to be that the skeletal remains of long-distance pack donkeys can be told from those used on the farm. Indications of the systematic adoption of pack-donkeys for long-distance transport might be obtained from study of changing routes and support systems, and from close examination of goods carried and any traces of their containers.

#### Changes in routes and settlement patterns

The likely physical locations and infrastructure of long-distance pack caravan routes in the Ancient Near East form a very large subject-area in themselves, not to be addressed here. Effects on infrastructure are likely to include the development of repackaging and transshipment points and waystations, and the necessary maintenance of desert and mountain routes by official, commercial or local initiatives (references to these subjects are listed in APP II.22). As noted above, pack-donkey caravans are recorded in texts as taking long detours to avoid interference; similarly, Joffe (1991:28) notes the 4<sup>th</sup>-millennium BC artefactual evidence of transport in the southern Levant taking place 'over great distances across arid zones by nomadic or semi-nomadic groups, rather than directly via the Damascus basin or Byblos.' From the thin evidence available, modern donkey-caravans in Africa actively avoid passing through most settlements, for speed and perhaps fearing taxation or other authority intervention, homing in instead on large regional markets. It might nevertheless be the business of new political centres in the Ancient Near East to attract caravans (Astour 1995:1401), for general communication facilities and to keep a controlling eye on trading activity (Algaze 2008:66, Larsen 2015:157); Akkermans and Schwartz (2003:204) note that in the 4<sup>th</sup> millennium BC 'important and prosperous communities of Syria were traditionally located along such routes, whether or not trade was their primary concern.' As an indirect example, in 17<sup>th</sup>-century AD Mesoamerica, the increasing replacement of llama transport by mule-trains led to greater Spanish control of trade and more transactions conducted between individuals rather than via the Indian authorities (Gil Montero 2009:40).

Evidence in Mesopotamia and the southern Levant demonstrates how new transport modes can change the balance of power and wealth of settlements *en route*, as they become a node/ transfer/ storage point, are bypassed, or develop

transport support services (APP II.22). In colonial Mexico, with the advent of mule and cart transport, arterial routes developed, with porters linking non-served areas to the roads (Hassig 1985:264) – the ‘railhead’ system noted in Chapter VII.1.

Similarly, the 20<sup>th</sup>-century AD development of containerised shipping

greatly increased the range of goods that can be manufactured economically at a distance from where they are consumed, the distances across which those products can feasibly be shipped ... and the ability of manufacturers to combine inputs from widely dispersed sources to make finished products. (Levinson 2006:281)

Mapping of the distribution of artefacts and of evidence of heavy-item manufacture (brickworks, potteries) along water and land routes is a well-established method of detecting traffic – though Teigelake (2003:155) warns that other factors, such as supply to settlers on fertile river-banks, might lead to erroneous conclusions about mode of transport. Artefact size, weight, fragility and value can also suggest likely transport mode, and consideration of packing arrangements can shed light: Bass *et al.* (1967:117/164) and Sherratt and Sherratt (1991:363) point out how odd extra items such as pottery can be tucked into boatloads more readily than land-carried packs. Yener (1983:3) reports that quantitative analysis of 3<sup>rd</sup>-millennium BC Mesopotamian artefacts at various Anatolian sites indicate a reverse correlation with the distance of the sites from regional arterial routes, both river and overland. Wilkinson (2016) is opening a new area of study in examining changing seasonality of routes according to mode of transport, while Adams (1974:247) suggests deducing changing raw material transport from information on finished goods (for example assuming wool transport from textile manufacturing evidence) and vice versa (as with metals).

Nielsen (2001:186) discusses the likely detectable features of camp-sites on modern llama-caravan routes, noting that overnight camps may be more frequently-placed than actual daily journey length as various factors cause delays, other caravans may already be in occupation, and caravaneers may have preferences relating to cultural group. Typically they will have a separate unloading/ loading area and hearth/ sleeping area, and Nielsen (2001:197) suggests that the extent of separation of sleeping-areas from the unloaded packs 'may reveal, at a behavioral level, a different relationship between drovers and the goods they transported in state-sponsored traffic' compared with goods owned by themselves. Woldekiros (2014) reports on bread-baking stones at both ancient and present-day caravan

campsites in Ethiopia, reflecting a group passing through and so needing to be self-sufficient.

Förster and Riemer's 2013 work cited above, and earlier publications, provides welcome examples of physical evidence for routes and waystations, on the 3<sup>rd</sup>-millennium BC Abu Ballas pack-donkey caravan trail in Egypt. The clearly fixed route, laid out and maintained by the Pharaonic regime (Riemer 2007:134) contrasts with those taken by caravans elsewhere avoiding attack and taxation. At the staging-posts, storage jars were replenished with water and grain by special caravans, and staff were stationed there to guard the provisions and bake bread for the caravans (Förster 2013:301-5). From the distance between them, Förster (2007a:5) calculates that 'the pack animals either walked c. 40km per day and were watered at the end of every second, or they needed three days at a rate of c. 25–30km to cover the distance, getting their water at the end of every third.' In a more recent example, Grant (1937:63) notes that in Syria the Romans dug a well every 28 miles (45km). Sufficient time for loading/ unloading, grazing and watering is another factor affecting when and where overnight stops are made (Larsen 2015:176, Riemer and Förster 2013:31), and the varying distribution of waystations could be a valuable pointer to changes of burden-carrier, from porters to donkeys.

The Abu Ballas trail has a striking series of orientation points formed of upright stone slabs or stacked stones (Förster 2013:297; Figure 55). Signs of roads, for all purposes and at all periods, can include 'stones, cairns, petroglyphs, trail-marker trees, stepping stones on canoe landings, rope and hand-and-foot rails, and wooden bridges' (Riemer and Förster 2013:29), and general evidence of investment in construction and maintenance. Clues from evidence of ritual sacrifice at the start of long journeys and at difficult crossing-points are suggested from both modern example on Bolivian llama-caravans (Nielsen 2001:170-72/178-82) and accounts from the early 2<sup>nd</sup>-millennium BC Kaneš texts (Larsen 2015:177). Förster *et al.* (2013:215) also suggest an archaeobotanical role, if 'the modern distribution of certain desert plants is shaped by the animals of a caravan (through preferential consumption and spreading), and/ or by humans who intentionally disseminate species to develop food resources along the travel routes.' I note in Chapter IX.1 use of remote techniques of detection of long-distance routes such as satellite imagery.





*Figure 55: Abu Ballas trail orientation cairn and resting-place (Förster 2007a, Fig. 6. © Rudolph Kuper, by permission)*

#### Pack containers

Detection of donkey transportation is inevitably constrained by the near-absence in the Ancient Near Eastern archaeological record of organic material such as basketry, wood (e.g. Levy *et al.* 2004:86), textiles, rope and leather. Förster (2007b:131) describes how on the Abu Ballas 3<sup>rd</sup>-millennium BC Egyptian desert donkey-trail, the 15kg pottery water-jars found stashed along the route were likely to have been carried empty in baskets, four jars per donkey, and repeatedly filled once in place from leather water-bags carried by other donkeys. Veenhof (1972:41-2) reports on clay bullae on the Kaneš route, attached to the bags or to textile hems, as small enduring clues.

In many cultures worldwide today loads from sacks to water-drums are simply tied onto the donkey, possibly with a saddle-blanket, sack, twigs, straw or mat to protect the goods from sweat and the animal from sores (APP II.22); saddle-blankets are seen in neo-Assyrian reliefs (Dercksen 2004:270), and in the early possible illustration of a cloth on a donkey for pack or riding seen in Figure 10 (Potts 2011:170). The donkey's narrow back makes paired loads very practical; these are evidenced in Near Eastern texts and depictions (Figure 37) and in modern times, and include cloth (saddle-bags or slung sacks), leather (for liquids, and for copper

and valuable textiles in the Kaneš trade), double baskets (to carry agricultural produce or large ceramic or wooden containers), nets as in the 2<sup>nd</sup>-millennium BC Egyptian Beni Hasan murals, and wooden holders for stones or sacks (APP II.22). In particular the double cloth or woven fibre saddle-bag is used widely in the Near and Middle East and Central Asia, filled with anything from flour to stones (Dercksen 2004:270, Digard 1982:139; Figure 56). Top-loading may be used where the item's unit weight is too great for the animal to carry two, though problems of stability ensue (Holstrom 1934:34, Sijpesteijn 1987:52). In the Kaneš caravans, a small top-pack was often added to the paired load (Veenhof 1972:23). Water-skins, too, are sometimes slung under the animal's belly (Fielding 1987:27, Nicolaisen 1963:110).



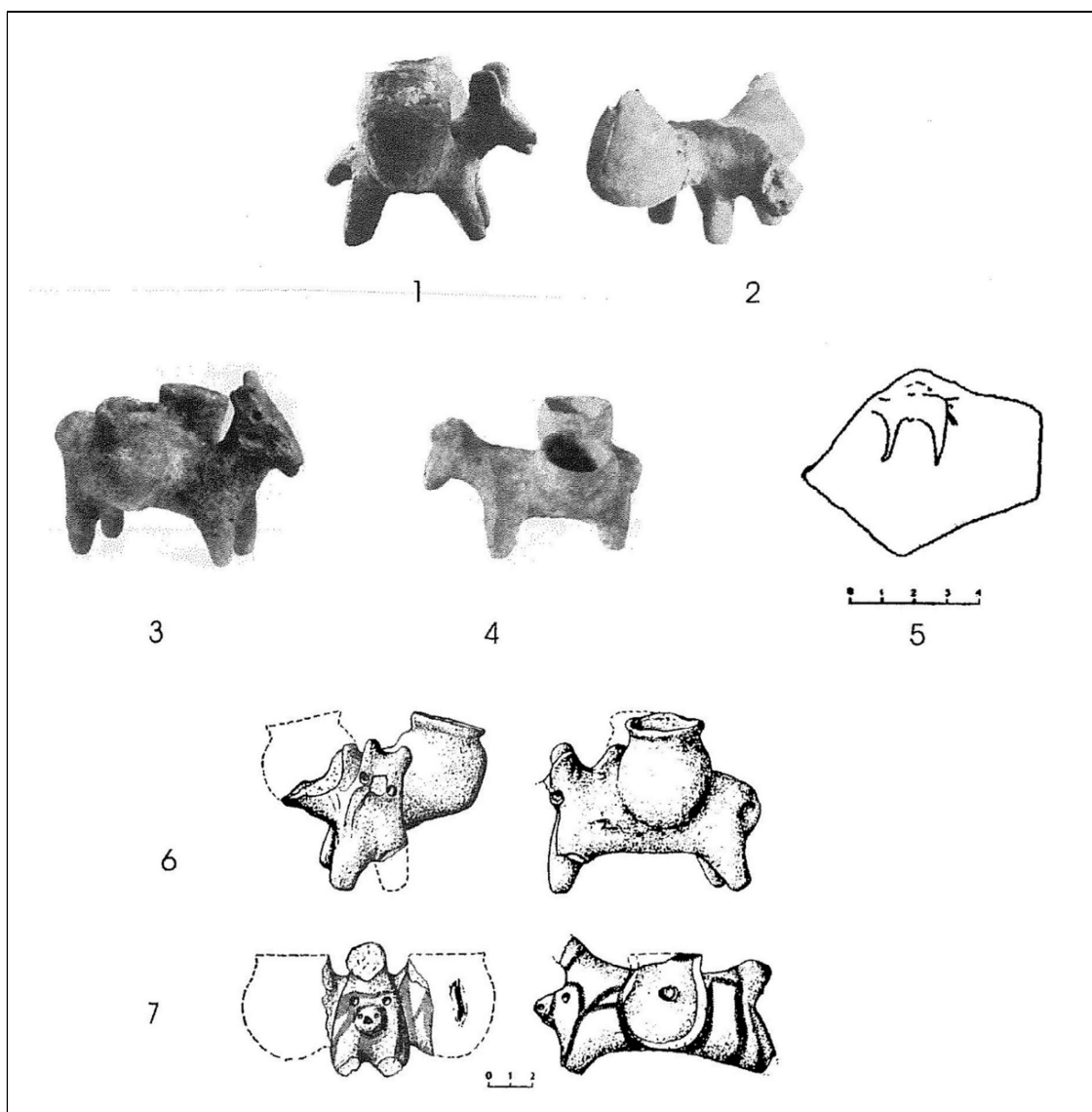
*Figure 56: Double basket (© Donkey Sanctuary 2013, by permission)*

Milevski (2011:183-93) discusses in detail the pack containers on the well-known late 4<sup>th</sup>-millennium BC donkey figurines from the southern Levant (APP II.21 and Figures 37 and 57). Although pottery containers were widely used for wine and other agricultural products, he considers that

[e]vidence from the donkey figurines ... is not conclusive regarding the utilization of pots as containers in the animal's burden in EB Canaan. Most of the cases show an open and deep bag-shaped container. As Amiran



(1985:192) has noted, the vessels of Figure 10.3:1 have no good parallels in the pottery repertoire of the period. She suggested that they are probably imitations of baskets. (Milevski 2011:190)



*Figure 57: Southern Levant donkey figurine photographs and drawings, EB II-MB II (Milevski 2011:185, Figure 10.3, by permission)*

Indeed, such open pottery containers are unsuitable for transport of liquids, especially long-distance, and their form may relate more to the constraints of the figurine-manufacturing process or even to possible use of the figurine for containing small funerary offerings. The risks of deducing practicalities from representations are underlined by improbable arrangements such as the well-known Chalcolithic ram figurine from Gilat, with its backload of three cornet-shaped containers (APP II.21).

Clues to the systematic adoption of boat transport have been sought in study of changes of jar shape (Parr 1973:172-7), and long-distance donkey-transport might be similarly detected through changes of container shape, volume and material, including greater uniformity for speed and efficiency of loading. A key sign of ubiquity of a transport mode is its use as a standard measure: in the Kaneš texts, *muttātum* – half of a pair of saddle-bags – was a measure for tin (Veenhof 1972:14), and from ancient Egypt onwards a donkey-load has constituted a measure of quantity for 'bulky and relatively cheap goods' (Brewer 2002:446).

### ***Implications for early use of working animals***

This chapter focuses on historical on-the-ground accounts of pack-donkey caravans in recent times, with notes on the very limited evidence of their emergence in antiquity. Recognition is advancing of the important role of the donkey for long-distance transport in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC, with increasing examination of indicative features and trends such as the geographical distribution of waystations and transshipment points, and of consequences such as new patterns of manufacturing location. Work on detection of changes of transport mode is also now being done through examination of pack container and route evidence.

Long-distance pack-donkey transport in all probability was not preceded by organised human porter caravans. The evidence indicates that early long-distance transport of goods was an informal relay process by mobile groups, who are also identified as likely early adopters of donkeys for *ad hoc* transportation work. As discussed in Chapter II.1-2, more systematic adoption of donkeys may have been stimulated by contact of mobile groups with urbanising cultures, as a solution to transportation of large-scale or heavy loads long-distance across difficult territory, and for feeder transport to boats.

Throughout history, long-distance transportation has generated need for exchange standards; accounts of pack-transport from Ethiopia and elsewhere indicate an interesting hierarchy of 'currencies', for example with salt bars at the strongest level and textiles and cereals as interim exchange products trading up to the salt standard. These examples might shed light on the financial basis of long-distance exchange as recorded in early texts and indicated in archaeological evidence, with a complexity of value operating below the recorded standard.

Meanwhile, the invisibility of long-distance pack donkeys throughout history is a sharp reminder of the likely extent of activity unrecorded in texts from the late 4<sup>th</sup> millennium BC onwards. Donkeys are ideally suited for moving of goods outside the inspection of authorities, via long desert or mountain detours and back routes as to the present day. Studies of more recent pack-caravans underline the importance of protection against banditry, which overlaps considerably with local tolls: '[t]here is nothing more stimulating to trade than security' (Grant 1937:62), achieved through guards and alliances but also through simple avoidance by routeing through difficult terrain.

## VIII SOCIAL IMPLICATIONS OF DONKEY AND CATTLE USE FOR WORK

### VIII.1 Cultural choices in working-animal adoption

I argue throughout this thesis, following my research aims (Chapter I.1), that archaeological thinking on the early systematic use of animals for traction and transport has been blurred by presumptions based on developed-world history and experience. Social and economic models to date almost wholly concern oxen, to the exclusion of donkeys (and cows), for which the equations differ considerably. Donkeys are a lower-cost, multi-function option, critically being invaluable year-round for local transport; I have discussed in Chapters V.4-.5 and VI.2 the usage of donkeys within communities including their widespread hiring and lending, and Chapter VIII.3 discusses their value for use by women. The multi-function virtues of cows are discussed in Chapter III.2.



*Figure 58: Impression of a cylinder seal, ED III (c.2400 BC). Upper register: equids (donkeys or hybrids) pulling a plough with a seed-funnel (Postgate 1992:168, Figure 8.4, IM 83755. Photo courtesy of Dr. Lamia Al-Gailani)*

As outlined in Chapter II.2, donkeys appear in Mesopotamian official records from the late 4<sup>th</sup> millennium BC as commonly-used agricultural animals (Figure 58). Heimpel (1995:91-3/134) analyses later 3<sup>rd</sup>-millennium BC Mesopotamian texts on ploughing animals, reporting that teams were mainly solely cattle or solely donkeys, with some temporary mixing, and that the ratio of donkey to cattle teams in Lagash

and Umma was respectively 3:4 and 1:3; the texts indicate that ploughing donkey numbers on state-controlled farms flourished in Ur III though were dwindling by the beginning of the 2<sup>nd</sup> millennium BC. Zarins (2014:193-5) additionally gives tables of the use of donkeys versus cattle in state-controlled agriculture at Girsu in the Ur III period. In Mesopotamia in the 3<sup>rd</sup> millennium BC, as the presence of pack-donkeys spread outwards through the regions, it could be suggested that they became adopted increasingly too in various roles in small-scale farming (known to exist in parallel with state-controlled farms – see Chapter II.1), under the radar of state operations and so of textual records. This invisibility persists today, with use of donkeys on small farms worldwide often excluded from official survey data (Kreike 2010:100, and APP II.34) despite their huge numbers in developing regions – a phenomenon with potential Sumerian parallels.



*Figure 59: Ploughing with a donkey and mule in Jordan (© Palmer 2014, by permission)*

Incidence of donkeys for ploughing in antiquity and now varies both practically and culturally, well beyond differences imposed by the comparative physiological and behavioural attributes of working donkeys and cattle (Chapter III.1). In Egypt donkeys were and are common pack animals but seldom used for ploughing despite suitable soils, and in Greece and Turkey the use of donkeys for ploughing is patchy though known from Classical times (APP II.31); however, donkeys are still used in

small numbers for ploughing in Syria, Jordan and Iran today (APP II.31, and see Figure 59).

Sub-Saharan African agricultural practices display a complex mosaic of practical and apparently cultural factors in the adoption or otherwise of different working animals, with many examples of adjacent groups using working animals differently. These cross-cutting factors have been the subject of particular discussion in recent years at ATNESA and other working-animal study workshops held in the region; APP II.34 gives references to country-specific and broader overview papers by specialists, as well as to published results from qualitative research projects in specific districts. The issue of unfamiliarity with animals generally and cattle in particular, as a barrier to adoption for work, is discussed in Chapter IV.2 under the heading of user training, and the reluctance of some cattle-herders to use their 'prestige' cattle for agriculture is noted below in the paragraphs on pastoralist and agriculturalist cultures. Russell (1998:49) lists likely archaeological indications of cattle kept for prestige or wealth: reduced animal size, cattle kept in areas 'not optimal in terms of subsistence' and far from settlements, indications that individual households are trading up to cattle from small stock, and cattle featuring in ritual and symbolism. In parts of modern Africa, cattle-herds are maintained largely for status reasons, with their care sometimes subcontracted to pastoralists (McCown *et al.* 1979). Singh notes from an assessment of working-animal use in Burkina Faso that donkeys can also attract prestige value:

owning draft animals such as donkeys, oxen, and horses, and equipment, is a symbol of social prestige. Households owning such capital enjoy higher socio-economic status in the community. Hence, there is incentive to have such items even when not used to the fullest extent possible. (Singh 1988:161)

Meanwhile, use of cows for work is for example common among Muslims in Asia and Egypt (see Chapter III.2), but in an unexplained contrast Muslims in sub-Saharan Africa often prefer not to use them. African Muslims also commonly deny their women the opportunity of using working oxen, and will commonly not eat donkey-meat (Blench 2004:24, Blench *et al.* 2004:213; and see Chapter IV.2); reports underline that these apparently religion-based trends are cross-cut by a range of other cultural taboos and practicalities, militating against simple cultural assignment. Commentators report that in developing regions today, 'cultural' differences in use of working animals can in a number of cases be traced back to

practicalities of terrain and environment (Halstead and Isaakidou 2011:62, Simoons 1960:6, Pingali *et al.* 1987:94).

Starkey (2000a:496) points out that central authority initiatives can be successful in initial introduction of animal traction (for example by subsidies and promotion) but less so in adjustment of the system to small-scale farmers' practical needs, local circumstances and cultural history. In several African countries in the 1970s and 1980s the central authorities introduced paired ox ploughing with heavy-duty implements (see Chapter I.2), but small-scale farmers increasingly on their own initiative and through word of mouth switched to single-animal donkey or cow draught and lower-power implements (APP II.13). Donkeys are often more suitable than cattle for ploughing in areas with light, sandy soil, aridity and heat, disease and parasites, and with scarcity of grazing, fodder or water (APPs II.3 and II.13, and see Chapter III.1). They constitute a valuable low-cost option for secondary tillage and light agricultural operations (APP II.13) – a feature already apparent in 3<sup>rd</sup>-millennium BC Mesopotamian records of task division by animal (Zarins 2014:190). Donkeys in modern usage also 'relieve rather than exacerbate the harvest bottleneck' (Brodie 2008:303 and see Chapter V.4) through their transport work, and are a highly flexible resource for general year-round use (APP II.31 and see Chapter VII.1) including income-earning work (APP II.7).

As discussed in Chapter II.2, donkeys attract both positive and negative connotations from ancient Mesopotamia and Egypt until the present day (APP II.34), with donkeys (as distinct from donkey ownership) rarely awarded the same prestige or symbolic value as cattle (Marshall [F.] and Weissbrod 2009:72). In modern societies donkeys are often insufficiently acknowledged as valuable work resources:

[t]he reasons for this include traditional negative attitudes towards donkeys and institutional neglect. In most cultures, there are common local sayings that reflect negative attitudes towards donkeys and ascribe poor attributes to donkeys. (Marshall [K.] and Starkey 1998:33)

There are striking African examples of suspicion among government authorities of donkeys, expressed in misleading and denigratory information disseminated by urban officials (APP II.34) and in ill-conceived culls, as vividly described in Jacobs' 2001 article *The Great Bophuthatswana Donkey Massacre*. Donkeys are often wrongly seen by external bodies as a poverty indicator (Cochin 1995:55) rather than an engine for change. Another element is the social assignment by men – in many

cultures the only users of working cattle – of donkeys for working use by women (see Chapter VII.1). As discussed later, women are often debarred for apparently cultural (but possibly acquisitive or power-oriented) reasons from using working oxen, but this often applies less to donkeys. An indicator, though, of the evolving status of donkeys in modern Africa – as distinct from their actual work value – is the commencement in some cultures of their acceptance as bride-price (Marshall [K.] and Starkey 1998:34), after long-term traditional exclusion in favour of cattle (APP II.34).



## VIII.2 Ploughing-animal adoption: ox-focused social inequality models

Modern African practices give ample demonstration of a complex spectrum of the immediate social effects of ploughing-animal adoption (see Chapters V.4-5), with a substantial sector using the ard plough for family subsistence and ease of back-breaking work, with some surplus for processing and exchanging at markets for household goods. Ploughing – a highly-seasonal task – may well be a minority usage, with the animals used for short-distance transport (Chapter VII.1) as part of the essential process of employing them year-round, with adopters commonly regarding this as an essential facet for offsetting acquisition and maintenance costs (Chapter V.5). Another key element rarely included in Ancient Near Eastern models of the economics of working-animal use, and the subject of one of my research aims, is the development of systems of hiring, lending and sharing of working animals. As discussed in detail in Chapter VI.2, the practice of spreading working-animal use among more than one user is recorded from antiquity onwards, with many modern studies of working-ox ownership strongly reinforcing the presence of these levelling dynamics. I describe in Chapter VI.2 how informal systems of 'loaning' the animals in return for obligation (typically expressed as help with the additional tasks generated by ox-ploughing), or as practical aid to needy relatives and neighbours, provide a feedback equilibrium that enables ox-ownership with its concomitant investment and year-round maintenance burden, while maintaining social relations using an existing asset.

In Ethiopia where ox-ploughing has (uniquely in sub-Saharan Africa) been practised since the early 1<sup>st</sup> millennium BC, McCann (1984, 1995) concludes through detailed historical and modern-day studies that although land was an important inheritance, the key factor in production was ploughing oxen, over both land and labour; in this pre-monetary society, intricate oxen supply and use systems evolved and continue today:

[w]hereas "rights in persons" were critical in labor-oriented rural economies, these were supplanted in Lasta with either ownership or "rights in" oxen which allowed particular households and elites to increase their hold over land and labor. (McCann 1984:4)

Wealthy households 'rent' oxen to poorer neighbours in return for labour and seed, tying indigent households to powerful ones and promoting stratification in the rural economy; in contrast, modest households with an ox-team loan it to indigent friends

or relatives, providing a levelling process at village level; and farmers with one ox team up with another to allow ox-team ploughing for both (McCann 1984:8-9). Philip (2001:187) echoes this latter approach with reference to social developments in Early Bronze Age I southern Levant, suggesting that 'the notion of corporate communities, composed of a variety of kinship-based units, would provide an alternative way of gaining access to and meeting the costs of draught animals'.

Farnham (1997:35) concludes in an overview of animal traction use in modern Africa that '[a] key question is whether the use of animal-drawn plows leads to socioeconomic differentiation between farmers. The available evidence is extremely murky', citing contradicting claims from a range of studies from Goody onwards. Adams detects similar murkiness in interpretation of archaeological signs of social inequality:

[l]evels of inequality in status, wealth, and power come to light in tomb furnishings, in discontinuous classes of settlement size, domestic architecture, and monumental construction, and in localized concentrations of costly or exotic materials from distant locales. But doubts linger about how closely gradations of control over human and other resources corresponded with these material vestiges that survive to be detected and measured millennia later. (Adams 2001:346)

Halstead suggests in 1987b that in the Aegean '[r]estricted access to scarce work animals and to expensive status items like chariot teams may thus have helped to consolidate the power of the elite groups which emerged during the Bronze Age' (p82); but more recently (Halstead 1995:18, 2014:318, Halstead and Isaakidou 2011:70) he expresses doubt as to whether ox-plough agriculture in 3<sup>rd</sup>-millennium BC Greece was a major contributor to the inequality becoming apparent at the time, suggesting that it was rather a precondition that allowed investment by the better-off in draught teams, with the new asset exchangeable for labour at peak times (Halstead 2014:318). In Neolithic Crete, few signs of major inequality accompany the adoption of draught cattle; Isaakidou (2008:104-10) suggests indeed that the use of draught cattle allowed those previously disadvantaged with more distant fields to keep pace with others, and that unequal access may have been managed by community arrangements (see Chapter VI.2) or by the use of working cows. While working cattle in the Mediterranean Neolithic were valuable not only for crop production but also in 'political economy (as means of mobilizing labor, earning prestige, and creating commensal debts) and in linking subsistence and political economy' (Halstead 2014:318), '[t]he durability of such inequality partly depended

on the strength of leveling mechanisms' (2014:319). Echoing Bogucki (1993:494), who concludes that in the European Neolithic '[m]any societies have levelling mechanisms that put a damper on excessive accumulation', he suggests that in some Bronze Age cultures these took the form of destroying dwellings and breaking possessions, which 'limited ... transmission of accumulated wealth and prestige across generations' (Halstead 2014:319).

The longer-term potential impacts of adoption of ox-ploughing on inheritance, marital and kinship arrangements have been well covered by anthropological commentators from Goody (1971, 1976) onwards, notably in papers in a special issue of *Current Anthropology* journal on 'Intergenerational wealth transmission and inequality in premodern societies' (2010, 51/1; see APP II.37) and in Borgerhoff Mulder *et al.* (2009:682); in this thesis I do not propose more than footnotes to their work. Goody puts in question Eurasian-based models of the social impact of agricultural development in sub-Saharan Africa: at farm level, while in Eurasia power and advancement may lie more in the control of land and its exploitation, in Africa (largely without the plough) land was sufficiently abundant (Goody 1971:25, 1976:107-8) while shortages of labour for manual agriculture could lead to power through control of labour, including slaves. Bogucki 1993:495 notes similarly that while '[i]n most parts of the world today, ability to acquire land is viewed as the primary factor limiting household subsistence production', 'in Neolithic Europe arable land was relatively abundant' and that the greater limiting factor was labour supply.

However, such discussion risks contrasting 'simple' ploughless horticulturalism with industrial-level plough agriculture featuring cash crops and perhaps abandonment of levelling mechanisms (Kelly 2010:109), and Hart (2011:23) suggests that "'Africa" seems to have lately become for Goody a static abstraction'. Shenk *et al.* (2010:66) ground the theoretical discussion by reminding us of Boserup's (1965) basis that alongside industrial-level ploughing systems 'the majority of people in such cultures may continue to live in rural areas and/or work in agriculture' (see Chapter II.1 on the 'private sector' in Mesopotamia), so have different drivers and priorities; Shennan (2010:115) reminds us of the significant inequalities also present in non-agricultural societies.

Goody, a proposer of some of the higher-level arguments discussed, rightly aims to transcend (1976:37) 'unilineal, single-factor hypotheses that dog so much work in

the social science', but does not enter into the complexities of the different ploughing animals and their capabilities and needs. He (1976:115) accuses himself of 'summarising summaries of summaries', adding that 'the view from the bird's eye does an injustice to the particular richness of life on the ground'; while his writings of course include on-the-ground detail from his own fieldwork in Africa, his greater aim is to examine the relationship between the adoption of plough agriculture and inheritance systems. My aim in this thesis has been to collate from the growing body of on-the-ground working-animal studies from Africa and elsewhere the small clues and descriptions of immediate social and economic impacts consequent on the advent of working animals in a range of modern communities. This has provided a nuanced and complex picture of local cultural adaptation to the use of working animals; I am not intruding on wider debates on the consequences of plough adoption such as revision of inheritance strategies, but clarifying the detailed effects of working-animal use which may eventually provide bottom-up adjustments to higher-level models.

### VIII.3 Gender inequality and working animals

This chapter, as with some others, is regrettably shorter than the subject justifies. There are known limitations to the archaeological and textual clues to the lives of women in Ancient Near Eastern complex societies; this has been addressed anthropologically by analyses of the changing social position of women in certain modern agricultural cultures, as for example by Goody's (1976) work on Murdock's (1967) *Ethnographic Atlas*. Commentators modelling social impacts of the adoption of working animals have commonly employed Marxist-related constructs for discussion of gender implications, such as property ownership, inheritance, labour use and power. While such drivers undoubtedly operate at all levels of society, high-level social models are by nature normative and should not be considered fractal in nature, mirrored at village or farm level. These models – with their influence on Sherratt's original secondary products hypothesis, as discussed earlier – focus strongly on the adoption of ox-ploughing, leaving unexamined the role of donkeys and also female cows, both commonly used for agricultural work in developing regions today. This example of the invisibility of the donkey is rectified to some extent by NGO and agro-economic published surveys on regions of modern Africa in particular, which report overwhelmingly on the benefit to women of the adoption of donkeys, for household and farm transport and in some circumstances for ploughing (APP II.5). However, while a strong practical case is therefore made for the transformation of the lives of women at household level, the next analytical step – of a robust but flexible hypothesis incorporating the working donkey as a force in gender relationship change in antiquity – has not yet been taken. It is not within the scope of this thesis to formulate such a hypothesis, but rather to signal its absence and the desirability of its evolution, while suggesting some building blocks for such an operation.

#### ***Women in Mesopotamia***

The position of high-status women in 3<sup>rd</sup>-millennium BC Mesopotamia is reinforced by textual references (Asher-Greve 2013:360-65, Stol 2016, Wright 1996:79/86), and in occasional depictions (Otto 2016:112-3). 'Accession through the female line was possible, and women occupied high positions in state, economy, and culture, could be head of a family, and had substantial legal rights' (Asher-Greve 2013:360). In parallel, the status of low-class women is also made clear in texts: they endured poor working conditions, received smaller rations than men and did not benefit from

land allotments (APP II.5). While female slaves are mentioned as hauling boats and weaving (Finet 1969:39-40, Tani 1996:404-5), Asher-Greve (2013:367) reports that '[t]he largest groups of low social status women are called géme, dependent female workers'. Texts and possible depictions from the 4<sup>th</sup> millennium BC record women working at low-grade textile manufacture (see below), as well as milling and oil-pressing (APP II.5).

Asher-Greve (2013:359) considers that '[f]ragmentary and uneven chronological and geographical distribution of sources preclude comprehensive reconstruction of the history of Mesopotamian women', citing evidence from anthropological research that women's lives in farming communities differ fundamentally from those in cities. Texts and the few depictions are often non-gender-specific or ambiguous, with debate as to whether 'low' individuals such as women might merit depiction (Breniquet 2016:23), and sources are overwhelmingly urban while the majority of the population was rural (APP II.35). Rita Wright (1996:79) argues that the state regulations displayed in texts reflect overall assumptions and arrangements concerning the role of women, and deduces (pp89-91) that the lives of female labourers did not include a significant family/ home element. Adams (2008:11-12) rebuts this, concluding from a re-examination of the statistics of women workers that 'a very high proportion of women were primarily engaged in their own subsistence pursuits and resided with their own families' (Adams 2008:11). Lafont (2016:163) supports this, suggesting that 'prisoners and slaves were probably confined to barracks, while "free" workers had their own home and independent family life, and came to work every day with their young children.'

My intention here, as a first move towards picturing the impact of working animals on the daily lives of low-status women, is to offer preliminary scenarios from modern studies of cultures in which working animals have a major influence on society and economy.

### ***Working oxen and women in present-day developing regions***

There is a large body of anthropological discussion on the exclusion of women from wealth and status through cultural barriers to their ownership and use of cattle. The longer-term Marxian trails of causation for the disenfranchisement of women are now discounted by many, while as I discuss throughout this thesis the recognition of

other animals than oxen for draught, and of the year-round importance of local transportation, suggests a more complex pattern of overall impact on the lives of women.

Reports on agricultural studies of ploughing-animal use in sub-Saharan Africa and elsewhere commonly record entrenched local views that ploughs and cattle are too heavy and difficult for women (e.g. Bwalya and Akombelwa 1999:83 in Zambia, Henriksson and Lindholm 2000:40 in Cuba); men consider it unsuitable for women to handle cattle (Bwalya 2004:131, Fowler 1999:271), and women themselves may feel culturally or physically deterred (Bwalya 2004:131, Lubwama 2000:125); there may of course be other factors such as the presence of young children. APP II.5 lists a range of published overviews and survey results, largely from sub-Saharan Africa, underlining the barriers for women.

Social analysts underline that 'social rather than biological factors' (Pearson *et al.* 2001:13) determine male and female roles rather than 'women's capacity or capability to handle draft animals' (Sylwander 1994:263). Comaroff (1985) underlines the long history of male ownership of 'prestige' cattle and argues the consequent ousting, though male plough use, of women from their traditional role as agriculturalists, adding (1985:72) that 'the role of cattle as signifiers ... is a perennial theme in the African anthropological literature.' In Ethiopia, where ox-ploughing has a far longer history than elsewhere in sub-Saharan Africa, 'the male monopoly of much of the cultivation process ... has fostered a marginal status for women in agriculture' (McCann 1995:74). Such barriers are also often evident in Islamic societies (e.g. Schmitz *et al.* 1991:85), and can relate to an association throughout history and prehistory of cattle-using with manliness; see Figure 29 in Chapter V.3, of a 4<sup>th</sup>-millennium BC seal showing two men attempting to master an ox, perhaps indicating the seal owner's ability to dominate powerful animals. Palmer (1998:144) notes that in modern northern Jordan farmers still equate the ard-plough with virility and fertility. In some modern societies cattle are inherited through the male line (Mofya and Chisenga 2000:128), and even where female cattle ownership is permitted these women may nevertheless be culturally required to hire in men to plough their land (e.g. Peters 1986:144-150, Starkey 1991:83). Men may wish to ensure continuing labour for 'female' work such as transporting water and fuel and carrying out manual field tasks – a gender-based division already evident in late 3<sup>rd</sup>-millennium BC Mesopotamian texts (Wright 1996:89).

Boserup (1990:23) and others (APP II.37) therefore argue that plough-led advanced farming – particularly if it involves cash crops – may increase the field-work that traditionally falls to women, who commonly take a large role in weeding and harvesting (e.g. Akou 1994:331, Floor 2003:216-7, Sylwander 1994:262 in accounts of sub-Saharan Africa and Iran). However, a large International Livestock Research Institute study in Ghana found that use of draught oxen instead laid more of the burden of consequent tasks on elderly and adolescent males (Panin 1987:6), and Goody (1976:33) suggests that the extra 'female' work may in practice be subcontracted to cheap seasonal hired labour, underlining the equivalent situation in many cases of women and disenfranchised labourers generally. Africa nevertheless has plentiful examples of female involvement in handling cattle: women plough in parts of Botswana, Malawi, Tanzania, Zambia and Botswana (APP II.5), and may take part in cattle-herding in Kenya (Spencer 1973:22). Anthropologists hoping for models are defied by the intricate variations in sub-Saharan Africa in particular, where 'interdependent and complementary female and male farming systems exist alongside each other' (Sylwander 1994:261).

While there is later occasional evidence of high-status women in antiquity owning cattle (Stol 1995:180, citing the 2<sup>nd</sup>-millennium BC Archives Royales de Mari (ARMT II 616:59-60) and a text from Sippar), it can be assumed that they did not manage the animals themselves; female slave 'ox-drivers' are mentioned in Old Babylonian texts (Stol 1995:193-4), though they are more likely to be leading the ploughing oxen (as commonly carried out by women in Africa today) than handling the plough; again in these texts, in a plough 'team' (comprising all the workers associated with a particular plough operation) 14 men and 2 women are listed, but the women are specified as being 'millers' (Stol 1995:194). Aside from such references, we have little clue as to gender constraints on handling of cattle at any level.

The emergence of gender inequality is ascribed by Friedrich Engels ([1884] 2004:151) to the appropriation of animal-related activities by males from the time of hunter-gatherers, continuing with the advent of private property consequent upon the domestication of animals for herding, and then to the oppression and exclusion of women through the adoption of working animals. Brewer (2004:19-21) argues too that the move from collective horticulture to individual plough agriculture led to a shift in women's work patterns. Goody (1976:33) reports from Murdock's (1967) *Ethnographic Atlas* data the correlation (with some lacunae (Goody 1976:23)) of 'male farming being associated with the more advanced agriculture, while female



farming is found mainly with simple agriculture' with its lower potential for lucrative cash crops (Schmitz *et al.* 1991:85). He further (1976:25) notes a specious argument by some that men may have been reluctant to take on plough agriculture as it shifted the burden of cultivation to them, but as discussed above, the indications are that men instead use these cultural taboos to exclude women socially (Lhoste 2004:127) and to keep the power and financial advantage of ploughing to themselves.

### ***Women and the impact of donkey adoption***

The earlier commentary on the social position of donkeys underlines how in contrast to cattle, throughout history and to the present day donkeys are commonly despised – notably by non-users – and regarded as low-status. An FAO working paper on animal traction worldwide notes that '[d]onkeys are efficient and easily-managed transport animals that can be of special benefit to women, and donkeys have fewer associations with masculine power than most other work animals' (Starkey 2011:27). A key conclusion, from this and similar overviews and workshop papers by agricultural and socioeconomic experts (APP II.5), is that such 'gender-neutral' attribution (Jacobs 2001:489, Starkey 2011:11 and APP II.34) provides women with consequent (or possibly causative) freedom to employ donkeys without the cultural constraints attached to cattle. 'Male-dominated societies often consider women as low-status citizens, while donkeys are low-status animals' (Marshall [K.] and Starkey 1998:33); among eastern African pastoral societies, '[m]any of the tasks for which donkeys are used are considered 'women's work', and donkeys are often considered women's animals and of relatively low status' (Marshall [F.] 2007:375).

A theme throughout this thesis is how donkey ownership allows women (and other subordinate categories such as landless males) not only to engage in ploughing but to conduct income-earning activity such as taking produce and goods to market and carrying goods for others. Ewers (1955:308-15) gives a parallel among Native Americans: with the advent of the horse, women in some cultural groups – the chief load-carriers – enjoyed higher social status and were freed to engage in other tasks such as craft production. In modern Africa,

[r]ural women are often extremely busy with household work ('reproductive tasks'), including the transport of fuel wood, water, food and children.  
...Donkeys may also offer women the opportunity to enter the usually male-

dominated income-generating ('productive') sphere. Donkeys can be used to transport materials for financial gain (e.g. transport of water, wood, forage, produce for market). This helps women (as well as men) gain money, status and, as a result, power. (Marshall [K.] and Starkey 1998:33, in a paper at an international animal-traction workshop in Ethiopia)

Meanwhile, as discussed in Chapter VI.2, the loaning of donkeys to neighbours and relatives is a valuable route to respect and status in the community.



*Figure 60: Women returning from market in Tigray, Ethiopia (© Donkey Sanctuary 2009, by permission)*

There is wide agreement that in many regions the traditional daily load-carrying tasks of women have been eased by donkey use (APP II.5, and Figure 60); in a major quantitative survey in Ethiopia, this easing is seen as the single most

important social contribution of donkey ownership (Admassu and Shiferaw 2011:8). As well as reduction of hardship, the delegation to donkeys of heavy load-carrying and manual cultivation work reduces reproductive and other medical problems in women (APP II.5). As discussed in Chapter III.1, donkeys correctly employed are docile and easy to handle by women, who can also therefore pass on to children daily tasks such as taking a donkey to collect water (APP II.5); more generally, adolescent children are commonly responsible for livestock care in Africa (APP II.5 and Chapter VI.1).

Isolated instances of cultural barriers to female use of donkeys do persist (see Chapter VII.1); and a striking feature of modern use of donkeys in daily village and farm life in developing regions is the divergence between male and female usage (APP II.5). Men are notably more likely than women to use donkeys for commercial transport for income (APP II.7), especially in urban areas, with women more likely to use them for rural household transportation. However, Hart (2011:18) argues cogently that the subordinate position of women in sub-Saharan Africa made them 'quicker to exploit the commercial freedoms of the neoliberal international economy' and more able to operate under established (male) polities. When Boserup (1990:14) argued that '[w]omen's work, women's fertility, and women's role in the family and in society at large are radically changed by economic development' – notably that involving new technology – she is referring to the negative effect, resulting in women's exclusion; the advent of the donkey in modern developing regions is therefore a guerrilla technology, reversing the effect and undermining established cultural rankings by proving the most useful to the less-privileged of a society.

Can any parallels be drawn with possible consequences for women in Mesopotamian society of any reduction of time spent carrying household and farm burdens? As I discuss above and earlier, there is 3<sup>rd</sup>-millennium BC textual evidence of the strong presence of working donkeys, but aside from the phenomenon of elite donkey-burials (Chapter II.1) there is a scarcity of identifiable donkey remains in day-to-day settlement contexts. This near-invisibility of both donkeys and women in the archaeological and textual record in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia is a significant obstacle, and future work may need to focus on re-interpreting social and economic changes at the time as possibly resulting from such adaptations.

## VIII.4 Pastoralists and agriculturists: divisions and links

Discussion of this factor in the social and economic implications of working-animal adoption surfaces commonly in both Ancient Near Eastern and modern working-animal treatises. I will not expand here on the keenly-debated origins and timing of mobile pastoralism and its variations, or on the timeline and kinship relationship with sedentary farming (see APP II.40 and notably Porter 2012). Sherratt (1981:262), following Goody (1976:4/119), sees plough adoption as dividing agriculturalists and pastoralists both socially and culturally (while acknowledging their continuing relations), though Comaroff (1985:146) records that adoption of plough agriculture by a cultural group in South Africa instead 'led to the intersection of the formerly discrete agricultural and pastoral sectors' leading to the domination of social systems by cattle-herding males through the defined role of cattle as signifiers of prestige and wealth (Comaroff 1985:60-72). Similarly, in China Tibbs (1989:3) records that with the advent of working animals the traditional divide between arable and livestock farmers became adjusted to a more complementary role. From another angle, Landais and Lhoste (1990:217-221/229) and Starkey (1994a:72) note that agencies attempting to impose high-yield agriculture systems on hand-cultivating African farmers in the mid-20<sup>th</sup> century AD – involving manuring and fodder production for animals – failed to appreciate the delicacy of inter-relation of agriculturalists and herders. One unanticipated issue was pressure on land: Levy (1983:30/104/107) suggests that in 4<sup>th</sup>-millennium BC Levant, full-time pastoralism emerged as a result of the need to keep herds away from new extensive crop-fields.

Altaweel and Paulette (2013:208) note that in the Bronze Age Near East some 'household-to-household exchange' is certainly likely to have existed, but

the archaeological and historical evidence for nomadic groups is patchy and incomplete and seldom permits any secure conclusions regarding the nature and consequences of economic interaction between nomadic and sedentary groups. Ethnographic analogy can be carefully employed to fill in some of the missing details, but the effects of long-term economic exchange between these groups remain inadequately understood. (Altaweel and Paulette 2013:204)

Ingold (1984:7) warns against confusing nomadism ('patterns of spatial movement') with pastoralism ('system of production'); Köhler-Rollefson (1992:11) suggests that 'archaeologists often tend to regard nomads as disruptive and antagonistic forces', and Bernbeck (2008:46-9) has taken issue with what he sees as a false dichotomy

between nomads and villagers, embraced by archaeologists observing daily life around their Near Eastern sites and reinforced by ancient and modern writings contrasting “wild” nomadic groups with “civilised” sedentarists. Porter (2012:10) reports on potentially misleading ethnographic models of a ‘conflictual relationship between tribes and the states that were seeking to subordinate them.’ Rowton (1973a:201) underlines the divide between those interacting strongly with sedentary groups (‘enclosed nomadism’) and ‘true’ nomads in desert regions (APP II.40), while Sasson (2010:17-18) adds the caveat that pastoral nomads nowadays are interacting with a modern market economy and may be more subject to lifeway constraints. Useful ethnoarchaeological investigation of modern such cultures has been common since Binford and Yellen in the 1970s, and continues, as with Alizadeh (2008) in the Zagros region and Palmer *et al.* (Palmer, Smith &c) 2007) at Faynan in the southern Levant, while new techniques have been developed (Chapters IV.1-2) for detecting pastoralist animal use from dung analysis at modern and ancient camp-sites.

Robertshaw and Collett (1983:74) suggest that it could be possible to detect cattle/crop divides archaeologically by identifying cattle-focused sites located far from fertile farming areas. If more data became available in the future, through further studies of farming communities in these regions, it could well be possible to disentangle these modern multi-factorial differences through statistical means, enabling analysis of the natural patterns of working animal adoption as indicators of social structure; such an approach is suggested by Spencer (1973:20) regarding physiological differences between different animals and the likely clan and family operative implications, and by Dahl and Hjort (1984:144-5) who argue that ‘different combinations of livestock could indeed provide a generative model for predicting forms of social organization.’

In many regions of Africa cattle (including those owned by crop-farmers; e.g. Jolly and Gadbois 1996:455) are largely kept by specialist mobile herders – the Fula/Peul in West Africa, and groups such as the Nuer and Maasai in the east. These are often reluctant to use their cattle for work, as they are unaccustomed to agricultural and transport activities and consider their cattle as prestige assets (e.g. Farnham 1997:127-833, in a report on a major government-sponsored two-year programme of interviews in northern Togo) – though practicalities such as their mobile lifestyle also play a role. Reports on the outcome of Government initiatives for example in Sierra Leone to introduce ox-ploughing indicate the multiple factors in adoption.

Among the Fula cattle-herders, some sub-groups (notably those adjoining ox-ploughing countries) successfully capitalised on their familiarity with cattle, while others did not take well to the process of cultivation. Among crop-farming groups unfamiliar with animal husbandry, a programme of training was successful in some cases, while others remained reluctant to handle cattle (Bangura 1990:324-5, Starkey 1981a:15, 1981b:21). These and other complexities in the varying adoption of working animals across cultural and other categories are a key subject of discussion in the publications and workshops of African working-animal forums such as ATNESA (e.g. Bangura 1990:324-5, Daramola 1999:236, Mwanzia 2000:240, Wood and Milimo 1994:344; see APP II.34, and Chapter I.2).

Pingali *et al.* (1987:92-4) suggest that any pastoral/ agricultural dichotomy in Africa is based more on practical constraints such as ecological niches, with a more complex mixing than some models allow. Jolly and Gadbois (1996:455) and Ruthenberg (1983:323) reinforce the impact of climate on the practice and extent of integration of animal husbandry and agriculture. Evidence from antiquity and more recently worldwide also indicates that while there may be differences in subsistence strategies (including adoption of working animals) between livestock specialists and crop-farmers, and sometimes conflict (APP II.40), commonly a symbiotic relationship exists, or even (Adams 1978:334) 'a two-way street, with individuals and groups moving back and forth along this continuum as a response to environmental and social pressures'; see also Porter 2012:24. The two subsistence-strategy groups may exchange products (including working animals (see Chapter II.1) and cooperate on use of land as with grazing on stubble/ fallow with manure provision (APP II.40), with important causative or consequent social relationships (Sasson 2010:15-17). Local markets for exchange of surplus benefits both groups: Halstead (2005) describes how in modern Greece the establishment of markets for exchange of pastoralist and agricultural products allowed each side to specialise in their metier rather than each farming household having to keep flocks in addition and vice versa.

Kin groups may comprise both mobile and sedentary sub-groups making a practical division of tasks (APP II.40 and see Porter 2012:13/24), as in the early 2<sup>nd</sup>-millennium BC Mari texts referring to tribes with both pastoralist and sedentary members (Matthews 1978:1, Porter 2012:25-7). Modern and historical examples show many mobile pastoralists also growing some crops, though the bulk of

agricultural products are still obtained from more sedentary groups (APP II.40). Rowton (1973b:252) notes that

[t]he Mesopotamian alluvial plain, relatively narrow, is bordered on both sides by pastoral country. In the steppes, water and pasture are lacking in the summer season and then the sheep have to be brought into the sedentary zone or to its fringe. In the mountains lack of pasture and lack of stabling made it necessary to move sheep down to the fringe of the alluvial plain during the winter months.

Meanwhile, donkey-use is a thread weaving through pastoralism from earliest times, as noted elsewhere in my thesis. Desert-region pastoralists may have been early domesticators of donkeys (Chapter II.2) and suppliers of a useful working animal to agriculturalists (Chapter IV.1) – and to urbanists, following Porter's (2012) new argument of the close involvement of pastoralists in state formation in Mesopotamia (Chapter II.1). To this day mobile pastoralists employ donkeys for local and long-distance transport (Chapters VII.1 and 3) including specialisation as caravaneers (APP II.36), and in many Near Eastern regions today are a universal all-purpose adjunct to daily herding of sheep and goats (Figure 61).



*Figure 61: Bedouin goat-herders with attendant donkey, Azraq, Jordan (© Dr. Michelle L. Stevens 2013, by permission)*



## VIII.5 Implications for early use of working animals

Models of early working-animal adoption for traction and transport have typically emphasised oxen, though by the 3<sup>rd</sup> millennium BC in Mesopotamia texts demonstrate that donkeys were also an established resource. Since the earliest times of their use, donkeys have commonly been held in low esteem despite their invaluable role, and in developing regions today their value – especially for small-scale farmers – is often ignored by (urban, high-status) officials focusing on large-scale cash crop projects, offering a potential analogy with antiquity (Chapter VIII.1). Models also risk adopting a binary approach, contrasting simple manual agriculture with advanced cash-crop production. As described in Chapter V.4, modern examples underline the common adoption of low-level ploughing by families to reduce back-breaking work rather than through a strong profit motive. Insufficient recognition is sometimes given to the extra work – weeding, foddering, transportation – generated by advanced plough agriculture, an issue in modern sub-Saharan Africa where labour rather than land can be at a premium (and is commonly obtained in exchange for hiring or lending of working animals). Chapter VIII.2 underlines that ploughing may well form a minority usage of working animals on farms, with benefit deriving at least as much from their year-round use for short-distance transport, as well as from the social and economic advantages of hiring and lending, levelling mechanisms widely in place among owners and users of working animals today (Chapter VI.2).

Modern studies nevertheless underline the known potential issues of unequal access to working animals, with wealth or power possibly a precondition rather than a consequence of ox-plough adoption (Chapter VIII.2), though considerably less so in the case of donkeys. The use of working donkeys in developing regions today, by women and other disenfranchised groups, makes use of what is effectively a guerrilla technology in societies where men retain status and control through cultural monopoly of ploughing cattle and delegation of load-carrying tasks (Chapter VIII.3). Not only is transportation work – commonly the work of women and of landless males – eased with the availability of donkeys, but income-earning capabilities and status in the community are importantly increased. The impact of working animals on the social situation of women in the Ancient Near East promises to be particularly difficult to detect, though, as not only are the daily lives of low-status women largely unrecorded, but a key potential asset, the working donkey, also commonly suffers from invisibility in the archaeological record.



The interaction of mobile pastoralists and agriculturists in antiquity (Chapter VIII.4) is noted in Chapter II.2 in the context of initial adoption of donkeys for work. While in sub-Saharan Africa there has been debate among official development groups promoting animal ploughing as to whether modern agriculturalists will learn to handle animals or pastoralists take to crop-growing, the actuality is more commonly one of symbiosis, based on occupation of ecological niches and on mutually beneficial exchange of products; both lifeways may be found within the same familial group.

## IX ANCIENT AND MODERN: FULFILLING RESEARCH AIMS

A central driver of my thesis, and my first research aim (see Chapter I.1), has been to demonstrate how interdisciplinary use of modern studies of working-animal use can shed light on likely working-animal husbandry and roles in antiquity, notably in helping to fill in the picture where archaeological and textual evidence is often thin, as in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia. In my closing Chapter IX.3 I present my strong argument for this approach, to encourage greater practical working-animal consciousness among field directors, specialists and overarching commentators, and to offer my analyses of modern development studies as an assistive framework for use in Mesopotamian working-animal studies and more broadly.

As I underline throughout my thesis, the data from antiquity on the actualities of working-animal adoption and use are fragmentary and can gain considerable richness from modern insights, through practical explanation of the likely material traces of working-animal breeding, use, care and disposal (see below). Emphasis in Mesopotamian archaeology has shifted increasingly to smaller rural sites and to broader landscape survey, using evolving techniques, and there are promising new detection and interpretation routes through zooarchaeological, archaeobotanical and other means, if a new working-animal mindedness is put in place.

In support of my second research aim, of challenging the ox-ploughing focus of current models of 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamian working-animal use, I first give in Chapter IX.1 an account of the insufficiently-acknowledged zooarchaeological and other factors in the marked invisibility of donkeys in the Mesopotamian archaeological landscape, with some suggestions for their better detection in the light of greater consciousness of their likely presence and of the practicalities of their use and management. Chapter IX.1 also summarises a further range of potential means, tangential to my core thesis subject of modern analogy, for potential more general detection of the role and impact of working animals in this period.

In Chapter IX.2 I address my research aims generally by demonstrating how a fuller understanding of the timeless practicalities of working-animal use can illuminate archaeological investigation. The unrecognised role of the donkey in particular, as

underlined throughout this document, is brought to the foreground. I offer modern data to demonstrate the overwhelmingly likely presence of various day-to-day activities related to working-animal use, large-scale employers of low-grade labour but barely considered in social and economic models of working-animal adoption.

## **IX.1 Detecting working animals in the archaeological record**

### ***Zooarchaeological detection of working donkeys***

Detection of the presence of working donkeys in the Near East from the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC is considerably impeded by the low incidence of donkey skeletal remains (Chapter IV.2): in many regions throughout history and to the present day, there is marked evidence of cultural (and practical) reluctance to eat working equids, with corresponding scarcity of bones in settlements. It is sometimes insufficiently recognised that the presence of animals used for work but not generally eaten can be seriously underestimated, and one of my research aims is to rectify this.

As I describe in earlier chapters, wide modern and historical example shows that in donkey-using regions these animals are found working universally – farms, villages, urban areas, caravan routes; but archaeologically the unique formation processes influencing deposition of donkey bones result in a find-pattern that cannot be taken to reflect the living animals' incidence or distribution. In addition to the issue of low incidence of eating – with variations perhaps more indicative of differences in cultural mores on the eating of donkeys – the remains of donkeys are unlikely to be found where they work, as for practical reasons they will be removed (Chapter IV.2), and their bones perhaps destroyed and scattered by predators.

#### Focus on food-middens

Mesopotamian archaeology during the 20<sup>th</sup> century AD suffered from unavoidable bias and incompleteness in surveys, and was necessarily influenced by cultural preoccupations of the time in its excavational emphasis on monumental architecture and elite material culture (see Butterlin 2010:134). It also reflected the means of site identification available at the time, with its inevitable focus on tells – the occupation mounds that dot the region. This emphasis is changing with growing detection facilities such as satellite imagery, and an increased focus on humans in the landscape (Wilkinson 2003:76); but the archaeological legacy still results in most animal-bone finds coming from food-refuse middens, often in urban environments. Such middens form a key source of evidence of working cattle, as the latter are almost universally used for meat at the end of their working lives; but there is still a paucity of recognition of the different deposition processes that apply in the case of donkeys.

### The issue of *Equus hemionus* in Mesopotamia

An additional obstacle in the study of early donkey use is the difficulty of distinguishing *Equus asinus* skeletal remains osteologically from those of onagers (*E. hemionus*) (APP II.44). Onagers are very similar skeletally to the donkey, with a natural range including Mesopotamia (Chapter II.2), but are effectively non-domesticable; they were hunted for meat and perhaps hides from early times, including in 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamia, and the presence of their remains (without expensive mitochondrial DNA analysis) can impede detection of domesticated donkeys. Site reports from the region typically list 'equid' remains, with a qualitative discussion of any evidence pointing to *E. asinus* or *E. hemionus* identity. For example, at 3<sup>rd</sup>-millennium BC Tell Sweyhat in northern Mesopotamia Jill Weber (1997:137) (commenting that '[e]quids are notoriously difficult to distinguish according to species, especially when ass and half-ass [onager] are in question') concludes that among the twenty equid bones recovered, three or four may be from (domesticated) donkeys.

### Detection of domestication

Unlike most livestock species, domesticated donkeys are not easily distinguishable morphologically from their wild ancestors, as from earliest to modern times donkey-using cultures have encouraged free breeding with the wild and made little use of selective breeding (Chapter IV.1); unlike species kept for meat or milk, the size and vigour of wild donkeys are prized virtues. I discuss in Chapter IV.1 the persisting tendency among some zooarchaeologists to detect donkey domestication by size reduction, despite strong modern and ancient evidence for the limited validity of this measure.

In addition to the clues from work pathologies noted in the next section, a range of osteological and particularly dental indications of constraints upon natural moving and eating may be detectable (APP II.44): evidence of fodder-eating from teeth wear and isotopic bone analysis (e.g. Mainland 2003, Makarewicz and Tuross 2006), crib-biting (though equids also gnaw tree-branches in the wild (Borwick 1971:21, Clutton-Brock 2001:336-8, White 1989:613)), rickets indicating indoor living, deciduous teeth found in enclosures, and trauma from hobbles. The issues of lip/nose-rings and bit-wear on donkeys of this period (APP II.44) are debated by specialists and I will not enter into them here; donkeys are rarely bitted for pack or traction.

Domestication over time may also manifest itself in non-functional distortions in equid tooth configuration (e.g. Uerpmann 1991:15) and of increased variability of tooth size and enamel pattern (Cattani and Bökönyi 2002:45). A preponderance of aged and disabled/ injured donkeys in the record (except in ritual circumstances) might indicate working use, as with cattle, as there are practical arguments against killing young, fit working animals (e.g. Bökönyi 1985:497, Fedele 2014:185); as noted in Chapter IV.2, aged donkeys are sometimes eaten.

Grigson (2003:220) and Ovadia (1992:19) consider that again as with cattle, there is a possible case for inferring domesticated donkeys from the percentage of equid bones in the total animal record increasing over time at a site; this argument could be extended to comparisons of donkey bone presence between settlements (allowing for settlement size). But aside from the significant disposal bias and issue of confusion with onagers noted above, such assertions would need to be supported by further arguments for their not being used (solely) for food or hides.

#### Location outside natural range

A primary identifier of working donkeys would be their presence outside their natural habitat; in Chapter VII.3 the potential for use of isotopic analysis for detecting the original locations of individual animals is illustrated. Donkeys are native to north-east Africa, and the presence of wild donkeys in Mesopotamia is not generally suggested, though there are suggestions of wild donkeys moving through Arabia to the southern Levant (Chapter IV.2); in such regions, specific additional evidence of domestication and work use would be required. As touched on in Chapter IV.1, recent studies are showing promising signs of the value of mitochondrial DNA in detecting domestication (and multiple ad hoc taming) evidenced by movement patterns and selective breeding (Evershed 2010), including increasing diversity of non-archaeologically-visible characteristics within a group, such as coat colour (Hemmer 1990:13). As underlined in Chapter IV.1 and throughout this thesis, donkeys stand out from many domesticated animals in not presenting a distinct genetic profile between wild and domestic. Marshall *et al.* (2014:6153) argue that traditional definitions of domestication reflect 19<sup>th</sup>-century AD intensive animal breeding practices, and that new genetic work is leading some to (p6157) 'question whether domestication remains a useful concept' in the case of animals such as donkeys.

## ***Zooarchaeological detection of working animals***

### Work-related traumas

It is not part of my thesis to go into the technicalities of detection of work pathologies, which have been well-discussed by zooarchaeologists. Chapter II.1 touches on their role in identifying adoption of working cattle and donkeys; commonly-cited clues are exostoses (protuberances on bones) and joint damage in the foot, leg and hip, as well as osteoarthritis (APP II.44). Bartosiewicz (2006:260) adds that checks could be made for example for symmetrical traumas and a concentration of pathologies in the rear of the animal; separately, Halstead and Isaakidou (2011:65) report a potentially useful find of limb pathologies suggesting habitual use as one side of a pulling pair. Traction use may also be seen in traumas from yokes and wither-harnessing (Bartosiewicz *et al.* 1997:27), and cord impressions on horn-cores (Milisauskas and Kruk 1991:562). As well as pathologies, clues may lie in altered muscle attachments as bones adapt to new muscle development in animals set to work (e.g. Olsen 2006:94, Turner 1998).

Work on detection of skeletal alterations from employment for pack work – certainly differing from traction traumas – has been more limited to date (Russell 2012:228). While it can be envisaged that use for pack may be visible in the vertebrae (Clutton-Brock and Davies 1993:214), Shai *et al.* (2016:11) observe for example that donkeys with their narrow packs are typically given paired side-loads, with different resultant pathologies from broad-backed pack animals, and from traumas caused by riding.

Shai *et al.* (2016:11) also comment on 'the difficulty of separating out natural variability and congenital defects from actual pathologies', and the continuing risk of equifinality of pathologies (Isaakidou 2006:107) is underlined by Bartosiewicz *et al.* (1997:69), who note for example that non-working cattle such as beef bulls and tied dairy cows 'confined to small spaces develop foot abnormalities at an early age'. Gidney (2013) supports this, noting from a detailed study of the skeleton of a modern well-developed dairy cow that weight can produce lesions similar to those considered to indicate traction.

### Other zooarchaeological techniques

In Chapter IV.2 I note the hypothesis relating to the southern Levant that an increase of cattle in the total animal record at a site can indicate adoption for ploughing, and outline commentators' arguments against this based on practicalities and present-day cattle-management systems in developing countries, where the resupply of oxen is managed in a smaller-scale, informal, community-wide system, much harder to detect. Varying husbandry practices, notably shared and multi-purpose animals, help to blur the pattern. Marciniak (2005:1) shows concern at what he sees as simplistic approaches to assessments of the importance of various animal species to humans by the proportions of the faunal sample, and (p237) 'advocates a research procedure of interpretive social zooarchaeology'. He argues (p238) that 'faunal remains, as debris from certain activities, were usually regarded as the patterned residues of these activities but were treated as representations of the economic system that structured these activities'.

These caveats apply similarly to models based on cull profiles (APP II.17), as summarised by Johannsen (2011:13):

[i]t has sometimes been assumed that draught exploitation will manifest itself in faunal assemblages as a relatively high proportion of bones from old (castrated) males. However, this assumption is not necessarily correct in all contexts. Historical sources, ethnographic observations and literature on modern agro-economic and farming development reveal substantial variation in known draught exploitation strategies. This variation highlights to zooarchaeology the importance of supplementing mortality patterns with other lines of evidence, such as artefacts, iconography and osteomorphology.

Thomas (2013:1) underlines too that

mortality and sex profiles only permit assessment of the proximity of theoretical models of optimised production in living herds to patterns observed in time-averaged accumulations of faunal remains. ... there are serious interpretative challenges posed by assuming a simplistic relationship between activity patterns and lesion formation.

In Chapter IV.2 the value and limitations of osteological evidence of castration are noted. While presence and age of castration is a potential indicator of a working ox, bulls are also castrated for other reasons (and not always castrated for work), and it does not detect working cows (Chapter III.2). Meanwhile, donkeys are not commonly castrated.



Meanwhile, domesticated animals may be marked in potentially archaeologically-identifiable ways such as horn-marking and (if hides are preserved) ear-clipping and branding (Marshall and Weissbrod 2009:71, Mudamburi *et al.* 2003:33, Wambui *et al.* 2004:27), if theft or straying is common, though modern instances show that the comparatively close relationship of working animals with their users often allows the latter to identify their animals without markings (e.g. JG Ethiopia 2014).

### ***Other potential evidence of working animals***

#### Texts and representations

I refer throughout this thesis to the limited relevant commentary on texts (see the explanation in Chapter I.1 of my approach) and to a lesser extent representational examples relating to use of working animals in antiquity, as indications of parallels with modern practices, though in my thesis I have not conducted detailed researches as these areas are actively under study by specialists. Zarins (2014:148) argues that 'it is likely that three-dimensional representations, figurines sculpted by those familiar with livestock and who know first-hand patterns of domestication, will afford the most reliable indicators of zoological data.' Breniquet (2002:148) suggests that depictions of certain animals on Uruk-period cylinder seals become more realistic, indicating a changed relationship with humans. While this provides useful supporting evidence, the inevitable bias in these depictions towards elite concerns and knowledge – and perhaps to traditional rather than current practice – contributes considerably to the invisibility of donkeys in this period, as discussed in Chapter II.1. Pournelle and Algaze (2014:21) suggest that Uruk-period iconography forms part of an idealised Soviet-Russia style depiction of farming processes under the aegis of controlling authorities:

'Irene Winter (2007) has recently reviewed the pertinent art-historical evidence and notes the incessant visual reference that the art of the time makes to domesticated grain and livestock, which she interprets as a self-conscious attempt by urban elites to legitimate themselves as providers of unending agrarian resources.'

#### Spatial evidence

Recent access to 1960s-70s CORONA satellite imagery of Near Eastern regions, and more newly ASTER multispectral imagery (Altaweel 2005, Pournelle 2003:46), has allowed Wilkinson (1993) and later investigators to map linear hollows in the

Mesopotamian landscape, initially in 3<sup>rd</sup>-millennium BC northern Mesopotamia but more recently in later periods and new regions. The short-distance versions that appear clearly in the 3<sup>rd</sup> millennium BC, radiating out a few kilometres from settlements, are broad and well-marked linear depressions, commonly interpreted as formed by the frequent movement of large flocks of sheep/ herds of goats moving perhaps daily to and from pasture on routes between agricultural fields (Casana 2013, Styring *et al.* 2017, Ur 2010:405-6, Wilkinson 1993). Farmers and their working animals may have commuted seasonally to fields on these same routes (e.g. Casana 2013:266), and future detailed analysis might provide help in detection of shifts to working-animal use (see Chapter VII.1 on distances to marginal land for cultivation).

Work has been done on analysing the incidence of middening (from abraded sherd scatters, e.g. Ur 2010:406), with the potential for detecting increased middening further from a farm or settlement. Styring *et al.* (2017) also report on new initiatives in isotopic analysis of archaeological cereal grain in northern Mesopotamia that indicate the extent of manuring. Overall increases over time might be attributable to more fields manured following the adoption of working animals (as suggested in Chapter VII.1 with reference to Knossos), and decreases to a move to more extensive cultivation enabled by ploughing. Styring *et al.* (2017:5) add from their isotopic analyses that it can also be possible to detect the distance from a household from which crops have been obtained, whether from use of more distant fields, communal land arrangements, or forms of village-based tribute, all with implications for transportation.

The potential for detection of working-animal corrals, stables, byres and indicators of tethering – reliant to some extent on working animal-mindedness during archaeological investigation and interpretation – is outlined in Chapter IV.2. I note there and in Chapter IV.1 the potential of satellite imagery for initial pinpointing of regional livestock markets and working-animal corralling areas. In Chapter IV.2 I also discuss new archaeobotanical and isotope capabilities in dung detection for identification of enclosures and animal species. Archaeobotanical work can also provide valuable clues to working-animal presence through evidence of large-scale fodder-growing to service animals unable to graze during working periods and needing intensive feeding in preparation for work (Chapter VI.1).

### On-the ground evidence

In Chapter V.1 I cover briefly the uncertain process of detecting ploughing-animal use from ard-marks; their spacing may also point to the animal species used, as may evidence of the scale of tasks relating to differing draught forces (Chapter III.1). Field shapes and their clues to the animals and ploughing practices used are referred to in Chapter III.1; the clearing of fields for working-animal ploughing is touched on in Chapter V.4, and may be detectable through for example the piling of stones in field corners, as still practiced in regions of small-scale farming in stony soil. Chapter V.4 continues with broader agricultural evidence of the potentially-detectable impact of the adoption of large-scale animal ploughing, including McCann's (1995:70) envisaging of the change of crops, inclusion of livestock husbandry and significant reorganisation of labour and land use consequent on the adoption of ox-ploughing in Ethiopia in the late 1<sup>st</sup> millennium BC. Evidence of storage of the new surplus of grain crops is touched upon in Chapter II.1, and archaeological evidence of threshing (equipment, chipped-stone wear, chaff cut-marks and animal trampling evidence, threshing floors, granaries and depictions) is discussed in Chapter VII.2.

As noted in Chapter VII.2, this thesis broadly excludes detailed discussion of evidence of wheeled vehicles, as there are significant limitations to ethnographic parallels, and in early Mesopotamian contexts their usage is now generally considered to be prestige-related rather than indicative of wide usage in daily transportation (Chapter II.1).

### Short-distance donkeys

The transfer to donkeys of the daily carrying of fuel and water may leave few traces (though see below on the physical human benefits of the reduction of manual work), but there might well be changes in farm-level spatial arrangements consequent on new transport capabilities for key tasks of transporting crops, fodder and dung from field to farm or to threshing-field or store, and from farm to village or market (Chapter VII.1), including the use of more distant fields. Outside urban and farming zones, the impact of donkey use by mobile pastoralists (Chapter VIII.4) may perhaps be detected through changed travel patterns in relation to water resources (and greater drought-survival), increased possessions and more elaborate dwelling-structures (e.g. Hole 1978:159-60, Marshall and Weissbrod 2009:60/69-73), and

changed relations with agriculturalists, with whom they may be exchanging goods and indeed donkeys.

Meanwhile, changes in the location and importance of manufacturing industries might give further indications of new capabilities for transporting heavy or bulky raw materials, as would evidence of increased use of construction materials from distant locations. A related process is that of local 'feeder' transfer from production points to 'railheads' (canal/ river ports and caravan collection stations): improved local transport capabilities allow streamlining of arterial routes, potentially archaeologically visible.

#### Long-distance donkeys

Modern example – or rather shortage of example – has underlined that caravaneers have throughout history had a strong interest in conducting profitable activities under the radar of authorities, and the advent of the donkey for long-distance transport may have provided such an evasatory facility from the earliest times of its use. The consequent difficulties of examining long-distance donkey pack-caravan activity both in antiquity and today are discussed in detail in Chapter VII.3. Mapping of consequent changes in routes and settlement patterns is accelerating with new GIS capabilities, and work has been done in Mesopotamia on changes in the distribution pattern of heavy/ bulky items, with potential for more on differentiation between boat and donkey transport patterns.

#### Replacing humans

Further detection potential may lie in indications of post-adoption redeployment of human labour (touched upon in Chapter VIII.3) and reduction in transport-related pathologies in humans. Austin (2016) reports how the extent of osteoarthritis in the lower limbs of workmen from 2<sup>nd</sup>-millennium BC Deir el-Medina in Egypt, compared with those of the women who remained in the village, indicates a likely link with their steep commute over the Theban hills to the Valley of the Kings. While these pathologies related to travel rather than pack, they demonstrate how a reduction in climbing- or pack-related pathologies among the non-elite might provide clues to their replacement on journeys by working animals.

Women have commonly worldwide been responsible for much short-distance transportation – notably of fuel and water – as well as manual cultivation work (Chapter VIII.3), and access to donkeys for transport, for women and for disenfranchised groups more generally, provides lifelines for both economic and social survival and enablement. The transfer of these tasks to donkeys – often more culturally-accessible to these groups than higher-prestige cattle – has been demonstrated in modern studies to reduce medical problems and pathologies in women, potentially detectable skeletally. Jones ([J.E.] 2010:17) cites Peterson's work on the Early Bronze Age southern Levant using 'skeletal data to track the gendered division of labor across the transition to agricultural life'. Marshall and Weissbrod suggest further, in discussion of modern Kenya, that

the association of household transport, women and donkeys might be tested in the future through the discovery of burials of women with donkey-related material culture such as donkey panniers and depictions of donkeys, or of rock art panels or donkey burials where women are associated with donkeys. (Marshall and Weissbrod 2009:75)

There are as yet no such clear clues to the association of donkeys in antiquity with women or other disenfranchised groups. The low profile of both donkeys and (low-status) women in the archaeological and textual record in 4<sup>th</sup>- and 3<sup>rd</sup>-millennia BC Mesopotamia is a significant frustration; possible future investigation might focus on re-interpretation of contemporaneous social and economic changes in the light of modern studies of the role and tasks of women.

## **IX.2 An ethological approach to working-animal use: challenging accepted models**

### ***Ox-ploughing models and the invisible donkey: lessons from modern studies***

To date there has been very little archaeological focus on systematic use of working donkeys in late 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia. A contribution to this lack of ‘donkey-mindedness’ may be historical species availability, with donkeys not a feature of northern Europe, resulting in ‘donkey-blind’ Westerncentric models of early working-animal systems. I argue throughout this thesis that archaeological commentators on early working-animal adoption have largely relied on unquestioning acceptance of high-level European and Asian anthropological models, with “oxen” (and working animals more generally) as an abstraction rather than as living creatures with their work capabilities, maintenance and husbandry requirements. In the case of Mesopotamia there has also been undue reliance on elite-commissioned representations of oxen and ploughing in possibly ceremonial contexts. It is often insufficiently acknowledged that working donkeys appear in texts from the late 4<sup>th</sup> millennium BC and are commonly listed as employed in centralised agricultural operations in the 3<sup>rd</sup> millennium BC. An additional element consists of the historical limitations of Mesopotamian archaeological and other evidence; as Algaze (2013:71) notes, the available findings from earlier archaeology in Uruk-period Mesopotamia ‘are uneven in quality and detail’, and until recent times fieldwork in 4<sup>th</sup>-3<sup>rd</sup> millennium BC Mesopotamia has been strongly settlement-oriented.

Donkeys could be said, too, to parallel organic materials in archaeological study, in that their near-absence from the excavation record (as I discuss in Chapter IX.1 above) too readily results in their neglect in interpretation, as in the instance of ploughing. As I make clear in this thesis, donkeys are widely used for ploughing in sub-Saharan Africa and other regions worldwide where mechanisation has not taken hold, particularly where grazing and water are issues and where on small farms a multi-purpose animal is desirable: ploughing donkeys are, too, universally used year-round for local transportation work. Small-scale farmers have also regularly taken advantage throughout history of the multiple year-round utility of female cows, which have been the main ploughing animal in Egypt since ancient times and are very widely used for work in Asia and parts of Africa. Wider acknowledgement of the presence and capabilities of working donkeys and female

cattle in the Ancient Near East opens a gate to better recognition of their likely role and of the greater complexity of working-animal systems in antiquity than was envisaged in the early days of the Secondary Products model.

Discussion of early animal use for cultivation has often assumed the desirability of deeper ploughing as practiced in temperate regions with heavy soil, and the consequent benefit of ox-ploughing. This model is countered by extensive experience in Africa, where deep ploughing can compact, erode and deplete light, arid soils (as common, albeit not universal, in Mesopotamia), and in many regions lighter tillage – for which donkeys are particularly suited – is preferred, particularly on small farms. While Mesopotamian texts clearly indicate massive centralised agricultural operations, the widespread presence of individual smallholdings outside the remit of the texts – perhaps using the multi-function and low-maintenance donkey – is now argued strongly by commentators, from archaeobotanical and other evidence.

Detailed modern evidence can also clarify confusion in theoretical discussion on the practical farming benefits or otherwise of ploughing versus manual cultivation. For example, as described in earlier chapters, yield increase – commonly placed at the centre of debate – is not necessarily the driver at small-farm level for adopting ploughing animals, and with the new burden of animal husbandry and feeding may shift labour rather than reducing it. Modern development studies, commonly examining small independent enterprises, give strong evidence of the intricacy of decision processes, by no means always driven by profit motivations. While archaeology will always have need of large-scale anthropological models, I argue in this thesis for a parallel ethological approach, envisaging the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC in Mesopotamia from a view-point explicitly acknowledging the major presence of working animals and their impact on human activity and the consequent archaeological record.

### ***Living with working animals***

#### Year-round utilisation and circulation of working animals

Extensive evidence from modern studies underlines that choice of ploughing animal, and of animal ploughing over manual cultivation, involves a complex interplay of uptake factors, notably the common economic necessity for year-round utilisation

outside the ploughing season (as I discuss in detail in Chapter V.5). In an inversion of commonly-held models of working animals generating wealth, the year-round burden of feeding and husbandry of oxen in particular brings an urgent requirement for offsetting; a vital contributor to this is the hiring, lending and multiple ownership widespread in modern and historical working-animal systems (Chapter VI.2). The circulation of working animals operates at both economic and social levels, providing currency in the form of labour or crops in return, obligation, status, and good kin and neighbour relations.

In Mesopotamia, with its centrally-owned ploughing animals, there are few textual references to working-animal hiring or sharing until late in the 3<sup>rd</sup> millennium BC, when in a Girsu text plough animals are transferred between households (Chapter VI.2). Early 2<sup>nd</sup>-millennium BC texts, though, show well-organised systems, including accounts from Mari of the governmental contracting-out of ploughing oxen to villages. Human labour, of course, is widely hired and parallels for working animals could potentially be assumed. Socioeconomic working-animal models nevertheless typically assume single ownership and use, though strong modern evidence suggests that models should rather be community-wide. Working animals in developing regions today commonly circulate around a community, reducing the total number of animals required and sharing the burden of husbandry while often reinforcing social relations. This practice may well even precede the recruitment of cattle for work, as throughout history in sub-Saharan Africa non-working cattle have been lent for the accrued economic and social benefits. The operation of such systems today can shed light on the practicalities of early investment in working animals and the associated social levelling mechanisms, notably in the social and economic agency potentially unfolded to women and landless individuals as noted in Chapter IX.1.

Further examining the factor of year-round utilisation (Chapter V.5), ploughing donkeys today are in practice likely to spend the majority of their time on farm or household transportation tasks, suggesting that the teams of ploughing donkeys described in 3<sup>rd</sup>-millennium BC Mesopotamian texts are very likely to have been employed for short-distance transport in addition (Chapter VII.1). One of the most striking themes emerging from modern sources is the difference in social and economic trajectories arising from adoption of working donkeys versus cattle, with little examination of the extent and operational practicalities in antiquity of daily



short-distance transport activities or of the social and economic impact of replacement of human pack by working animals (Chapter VIII).

Finally, modern analogy brings forward powerfully the likely proliferation of new industries and occupations consequent on the systematic adoption of working animals (Chapter IV), major employers of labour which are barely discussed in models of working-animal adoption in antiquity.

#### Breeding and supply

Accounts of the large-scale breeding and supply of donkeys for work in modern developing regions provide potential clarification of such systems in antiquity, with the scattered textual references indicating promising parallels. In Chapter IV.1 I note 3<sup>rd</sup>-millennium BC texts from Lagash, Mari and Tello referring to transfer of donkeys from large official centres in eastern and central Mesopotamia to areas of high work-demand, as happens on a huge scale in parts of sub-Saharan Africa today. Modern analogy also helps to explain the near-absence in the texts of references to the actual breeding of donkeys, which unlike the supply systems is typically conducted well outside official control, in remote, arid regions, with donkeys transferred long distances to exchange centres. Provision of working cattle differs significantly from the donkey-supply system, both then and now, in that the process focuses in the main on training cattle for work from a more general herd rather than separately breeding specialist work-cattle. Chapter IV.1 describes references in late 3<sup>rd</sup>- and early 2<sup>nd</sup>-millennium BC texts to official cattle-supply stations, dealing (and training as needed) with both working and non-working cattle; there are accounts of a system of providing oxen for ploughing by castrating and training calves delivered to the temple as tribute.

#### Foddering and grazing

On a more local scale, foddering of both working cattle and donkeys has a long history; Chapter VI.1 notes Girsu, Nippur, Beydar, Mari and Lagash texts on the subject from the 3<sup>rd</sup> millennium BC and increasing recognition in contemporary zooarchaeological and archaeobotanical evidence. Modern evidence does much to provide the context and to indicate the large scale of labour and transportation needed. Feeding of working cattle involves close scheduling of grazing and watering time, and – given those limitations, and the additional need for concentrated nutrition – a complex process of high-volume growing of fodder and provision of crop residue, with land, labour, transportation and storage challenges. Working

donkeys present less of a burden: they can – except in urban locations – forage for themselves on rough, dry material; they normally graze at night and unlike cattle do not require periods for rumination. Modern studies give clear examples of new adopters of working animals struggling to adapt to these new needs, notably if animals are working far from food and water resources.

## IX.3 The way forward

### *Introduction*

These findings are not conclusions but incentives to revision of research approaches. The wider intention of my thesis is to provide a start, not an end. A key aim has been to supply information and resource material on my subject, seeking new clues to links between the animal record and the broader contexts in which they are embedded, particularly through ethnographic analogies and ethological consideration. In this I echo Johannsen (2011:13), who aims in his paper 'Past and present strategies for draught exploitation of draught cattle'

to contribute towards informed investigations of the practice and role of this technology in past contexts. ...it is, above all, meant as a pool of background knowledge that zooarchaeologists and others studying past cattle husbandry may draw upon in their interpretation. The basic theoretical premise of this paper is that we will benefit as little from ignoring the information available on cultural variation in different types of human-animal relationships as we will from uncritically employing analogy (explicitly or implicitly).

The value of my thesis lies not in the formulation of a new high-level theory, but in the assembled detail in the body of the chapters, which through emerging themes and practical demonstration of working-animal systems provides guidance for archaeologists and zooarchaeologists interpreting features of Ancient Near Eastern sites and seeking new clues to links between the animal record and the broader contexts from which they come, particularly through ethnographic analogies and ethological consideration.

As I discuss in Chapter I.2, regions with significant use of working cattle and donkeys today are inevitably not susceptible to detailed data collection, for reasons of funds and physical difficulty. Animal-based farming and transport work therefore takes place largely outside the surveillance of central authorities and certainly with very little realistic statistical recording; we are left at an almost Mesopotamian level of information on these activities. I have therefore employed a rigorous qualitative analysis approach to the modern studies available, drawing on a previous career in industrial market research consultancy. My approach is explicitly heuristic and works towards filling practical gaps in the higher-level anthropological models proposed by Goody and others. While I sometimes challenge these larger models on practical grounds, I do not aim to propose alternative models; my focus is at a

lower level, providing complementary enrichment of the landscape of working animals in the present and past.

### ***The way forward***

A promising way forward, for reducing the invisibility of working animals and progressing towards greater appreciation of their nature, role and impact, consists of a combination of approaches including greater working-animal consciousness in excavation contexts, the pursuing of new detection techniques such as isotope analysis, archaeobotanical tracing of dung concentrations, foddering and manuring, satellite imagery, and the active employment (with caveats – Chapter I.2) of ethnographic and ethological analogy to create greater understanding of the circumstances in which donkeys, oxen and cows might be systematically used for work. An ethological approach, bringing into archaeological consciousness the living working animals, places them alongside humans in the societies within which they operate. Arbuckle (2012b:302) joins me in his assertion that

Despite the fact that early texts from the late fourth and third millennia BC clearly indicate that animals and their diverse products were central concerns of early states..., there have been few attempts to contextualize the role of animals within the processes that led to the rise of complex societies in the ancient Near East. ... This developing direction for zooarchaeological interpretation focuses on animals as highly socialized entities fully integrated within a range of cultural systems and actively used in a wide variety of social contexts.

As noted in Chapters II.1 and VIII.2, I am not engaging significantly in the complex debate as to whether various archaeologically-visible elements were preconditions, planned or unexpected outcomes, or concomitant or contemporaneous features of the adoption of working animals. Further research into causation and circumstances nevertheless promises to be valuable not only for large-scale models of the role of working animals in 4<sup>th</sup>- and 3<sup>rd</sup>-millennium BC Mesopotamia, but also for understanding in detail the circumstances likely to cause or result in the flowering of working-animal use, and of the circumstances leading to choices between oxen, cows and donkeys (see Chapters III.2 and VII.1).

The coinciding of such suitable, desirable or exigent conditions can prove a valuable alert for site directors and laboratory researchers to work with heightened

awareness of the possibility of detecting working animals when studying structures, installations, artefacts and spatial arrangements as well as animal and botanical remains. Sherratt (e.g. 1981, 1983:99), discussing developments such as urbanisation, similarly favours consideration of preconditions and conjunctions of circumstances, arguing (1997a:13) that 'important innovations more usually start at particular, unusual points on the Earth's surface where rare sets of conditions coincide'.

Mesopotamian archaeology in the 21<sup>st</sup> century AD is adjusting to accelerating change in fieldwork constraints, technical capabilities and interpretative challenges. New models for the developments in exploitation of secondary products in the 4<sup>th</sup> and 3<sup>rd</sup> millennia BC must now include a reassessment of the vital supporting role of the 'other' – the non-humans added to the work-force who supported social and economic transformation at the highest and lowest levels.

A key aim of archaeological interpretation is to understand the people of the past, and it may seem banal to suggest that such people did not live in isolation in a passive, motionless world otherwise devoid of life. Humans exist within a world consisting of many other living, dynamic beings in a mutually constituting relationship. (Jones [P.L.] 2009:75)

While there has been acknowledgement of the role of cattle for ploughing, the working donkey in particular walks invisibly between the high-level anthropological models of Goody and Boserup with their focus on ploughing oxen, and site-focused zooarchaeological reports with their scarcity of non-food animals. Goody himself (1976:115), although committed to model-devising, emphasises that 'the view from the bird's eye does an injustice to the particular richness of life on the ground'. The use of data and observations from widely-available modern agricultural, social and economic development studies, in regions of significant working-animal use such as sub-Saharan Africa, is a largely-untapped resource for Ancient Near Eastern archaeologists. With suitable caveats it provides a means of rebooting archaeological thought and placing working animals within a newly-assessed social and economic framework focusing on practicalities and on household-level responses to change.

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